Central Radio Propagation Laboratory

IONOSPHERIC PREDICTIONS

for

June

1963

TB 11-499-3/TO 31-3-28

U.S. DEPARTMENT of COMMERCE
National Bureau of Standards
Number 3/Issued March 1963

U.S. DEPARTMENT OF COMMERCE
Luther H. Hodges, Secretary

NATIONAL BUREAU OF STANDARDS
A. V. Astin, Director

Central Radio Propagation Laboratory

Ionospheric Predictions

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[Formerly "Basic Radio Propagation Predictions," CRPL Series D.]

The CRPL Ionospheric Predictions are issued monthly as an aid in determining the best sky-wave frequencies over any transmission path, at any time of day, for average conditions for the month. Issued three months in advance, each issue provides tables of numerical coefficients that define the functions describing the predicted worldwide distribution of foF2 and M(3000)F2 and maps for each even hour of universal time of MUF(Zero)F2 and MUF(4000)F2.

NOTE: Department of Defense personnel see back cover.

Use of funds for printing this publication approved by the Director of the Bureau of the Budget (June 19, 1961).

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National Bureau of Standards

The functions of the National Bureau of Standards are set forth in the Act of Congress, March 3, 1901, as amended. These include the development and maintenance of the national standards of measurement and the provision of means and methods for making measurements consistent with these standards; the determination of physical constants and properties of materials; the development of methods and instruments for testing materials, devices, and structures; advisory services to government agencies on scientific and technical problems; invention and development of devices to serve special needs of the Government; and the development of standard practices, codes, and specifications. The work includes basic and applied research, development, engineering, instrumentation, testing, evaluation, calibration services, and various consultation and information services. The Bureau also serves as the Federal technical research center in a number of specialized fields.

Central Radio Propagation Laboratory

The Central Radio Propagation Laboratory at Boulder, Colorado, is the central agency of the Federal Government for the collection, analysis, and dissemination of information on propagation of radio waves at all frequencies along the surface of the earth, in the atmosphere, and in space, and performs scientific studies looking toward new techniques for the efficient use and conservation of the radio spectrum. To carry out this responsibility, the CRPL—

1. Acts as the central agency for the conduct of basic research on the nature of radio waves, the pertinent properties of the media through which radio waves are transmitted, the interaction of radio waves with those media, and on the nature of radio noise and interference effects. This includes compilation of reports by other foreign and domestic agencies conducting research in this field and furnishing advice to government and nongovernment groups conducting propagation research.

2. Performs studies of specific radio propagation mechanisms and performs scientific studies looking toward the development of techniques for efficient use and conservation of the radiofrequency spectrum as part of its regular program or as requested by other government agencies. In an advisory capacity, coordinates studies in this area undertaken by other government agencies.

3. Furnishes advisory and consultative service on radio wave propagation, on radiofrequency utilization, and on radio systems problems to other organizations within the United States, public and private.

4. Prepares and issues predictions of radio wave propagation and noise conditions and warnings of disturbances in these conditions.

5. Acts as a central repository for data, reports, and information in the field of radio wave propagation.

6. Performs scientific liaison and exchanges data and information with other countries to advance knowledge of radio wave propagation and interference phenomena and spectrum conservation techniques, including that liaison required by international responsibilities and agreements.

Introduction

The "Central Radio Propagation Laboratory Ionospheric Predictions" is the successor to the former "Basic Radio Propagation Predictions," CRPL Series D. To make effective use of these predictions, National Bureau of Standards Handbook 90, "Handbook for CRPL Ionospheric Predictions Based on Numerical Methods of Mapping," should be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., price 40 cents. This Handbook includes required additional data, nomographs and graphical aids, as well as methods for the use of the predictions. The Handbook supersedes the obsolete Circular 465.

The basic prediction appears in tables 1 and 2, presenting predicted coefficients for foF2 and M(3000)F2 defining the numerical map functions describing the predicted worldwide variation of these characteristics. With additional auxiliary information, these coefficients may be used as input data for electronic computer programs solving specific high frequency propagation problems. The basic equations, their interpretation, and methods of using the numerical maps are described in two papers by W. B. Jones and R. M. Gallet, "The Representation of Diurnal and Geographic Variations of Ionospheric Data by Numerical Methods," Volume 66D, Number 4, July-August 1962, pages 419-438, and "Methods for Applying Numerical Maps of Ionospheric Characteristics," Volume 66D, Number 6, November-December 1962, pages 649-662, both in the Journal of Research of the National Bureau of Standards, Section D. Radio Propagation. The predicted numerical map coefficients of tables 1 and 2 may be purchased in the form of a tested set of punched cards. Write to the Prediction Services Section, Central Radio Propagation Laboratory, National Bureau of Standards, Boulder, Colorado, to arrange for the purchase of the set of punched cards and for further information and assistance in the application of computer methods and numerical prediction maps to specific propagation problems.

The graphical prediction maps, derived from the basic prediction, are provided for those unable to make use of an electronic computer. Figures 1 to 12 present world maps of MUF (Zero) F2 and MUF(4000)F2 for each even hour of universal time. Figures 13 to 16 present the same predictions for hours 00 and 12 universal time for the North and South Polar areas. Predicted polar maps for each even hour of universal time may be obtained by special arrangement with the Central Radio Propagation Laboratory. The Handbook describes methods for including regular E-F1 propagation. Figure A is a graph of predicted and observed Zürich sunspot numbers which show the recent trend of solar activity. Table A lists observed and predicted Zürich smoothed relative sunspot numbers and includes the sunspot number used for the current prediction.

Members of the U.S. Army, Navy, or Air Force desiring the Handbook and the Ionospheric Predictions should send requests to the proper service address; for the Navy: The Director, Naval Communications, Department of the Navy, Washington 25, D.C.; for the Air Force: Directorate of Command Control and Communications Headquarters U.S. Air Force, Washington 25, D.C., Attention: AFOCCAA. Army personnel should refer to the Handbook as TM 11–499 and to the monthly predictions as TB 11–499–( ), predictions for the month of June 1963 being distributed in March 1963 and designated TB 11–499–(3), and should requisition these through normal publication channels.

Information concerning the theory of radio wave propagation and such important problems as absorption, field intensity, lowest useful high frequencies, etc., is given in National Bureau of Standards Circular 462, "Ionospheric Radio Propagation." This may be obtained from the Superintendent of Documents, price $1.25 (to foreign countries, $1.65). A revised work is in preparation which will be announced in the Ionospheric Prediction series when available. Additional information about radio noise may be found in C.C.I.R. Report Number 65, "Revision of Atmospheric Radio Noise Data," International Telecommunication Union, Geneva, 1957.

Reports to this Laboratory of experience with these predictions would be appreciated. Correspondence should be addressed to the Predictions Services Section, Central Radio Propagation Laboratory, National Bureau of Standards, Boulder, Colorado.

Table A

Observed and Predicted Zurich Smoothed Relative Sunspot Numbers

Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1952	43	42	39	36	34	32	31	29	28	28	27	26
	(53)	(51)	(52)	(52)	(52)	(52)	(51)	(49)	(46)	(43)	(38)	(33)
1953	24	22	20	19	17	15	13	12	11	10	9	7
	(30)	(29)	(27)	(24)	(22)	(21)	(20)	(18)	(18)	(17)	(16)	(15)
1954	6	6	4	3	4	4	5	7	8	8	10	12
	(14)	(12)	(11)	(10)	(10)	(9)	(8)	(8)	(8)	(10)	(10)	(11)
1955	14	16	20	23	29	35	40	46	55	64	73	81
	(12)	(14)	(14)	(13)	(16)	(18)	(22)	(27)	(30)	(31)	(35)	(42)
1956	89	98	109	119	127	137	146	150	151	156	160	164
	(48)	(53)	(60)	(68)	(77)	(89)	(95)	(105)	(119)	(135)	(147)	(150)
1957	170	172	174	181	186	188	191	194	197	200	201	200
	(150)	(150)	(150)	(150)	(150)	(150)	(150)	(150)	(150)	(150)	(150)	(150)
1958	199	201	201	197	191	187	185	185	184	182	181	180
	(150)	(150)	(150)	(150)	(150)	(150)	(150)	(150)	(150)	(150)	(150)	(150)
1959	179	177	174	169	165	161	156	151	146	141	137	132
	(150)	(150)	(150)	(150)	(146)	(143)	(141)	(142)	(141)	(139)	(137)	(137)
1960	129	125	122	120	117	114	109	102	98	93	88	84
	(136)	(135)	(133)	(130)	(125)	(120)	(118)	(115)	(110)	(108)	(105)	(100)
1961	80	75	69	64	60	56	53	52	52	51	50	48
	(100)	(90)	(90)	(90)	(85)	(85)	(80)	(75)	(70)	(70)	(65)	(60)
1962	44	41	39	38	38	37						
	(60)	(50)	(48)	(45)	(42)	(37)	(34)	(31)	(29)	(28)	(27)	(34)
1963												
	(31)	(28)	(26)	(25)	(25)	(25)*						

Note: Final numbers are listed through June 1961, the succeeding values being based on provisional data. The predicted numbers are in parentheses.

* Number used for predictions in this issue.

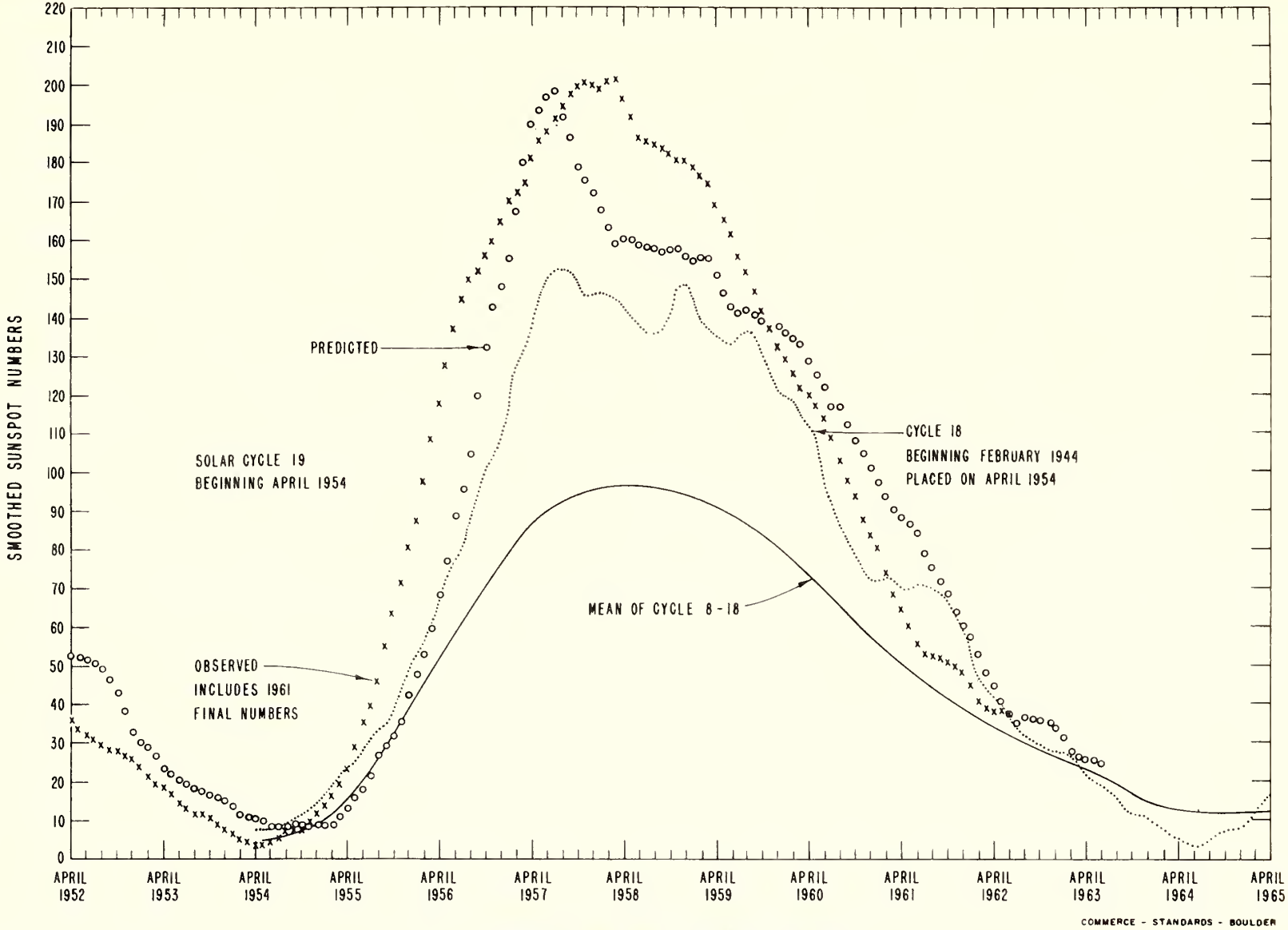

FIG. A. PREDICTED AND OBSERVED SUNSPOT NUMBERS

TABLE I

TIME VARIATION

GEOGRAPHICAL VARIATION

Harmonic		0	1		2		3		4	
	K \ S	0	1	2	3	4	5	6	7	8
I	0	6.3616863E 00	1.4603118E 00	1.8458435E 00	-3.7579392E-01	1.2345805E-01	-4.1155655E-01	-4.8877851E-01	2.8943523E-01	-4.0952426E-02
	1	6.8888481E-01	3.3025786E-01	-6.1949423E 00	3.1762918E-01	-1.4624938E 00	5.4503907E-02	1.0089923E-01	6.1380851E-02	5.2227966E-01
	2	-7.3134684E 00	4.8615986E 00	1.0030482E 01	1.6207853E 00	-3.7081559E 00	1.3787994E 00	5.0004165E-01	-1.6072730E 00	1.4316292E 00
	3	1.7012039E 01	1.6401898E 01	6.7897459E 01	1.6438430E 00	2.6733572E 00	1.6246300E 00	1.3206831E 00	2.0223716E 00	2.1359649E-01
	4	4.9086078E 01	-6.8658689E 01	-1.2343683E 02	1.1577900E 01	3.9956554E 01	-4.7172180E 00	5.0709140E 00	9.1958916E-01	-1.4478403E 01
	5	-1.0742907E 02	-1.2116415E 02	-1.4572548E 02	-2.6825290E 01	-1.3886566E 01	-1.3026006E 01	-7.3173242E 00	-6.4631110E 00	-6.0547266E 00
	6	-1.9304632E 02	2.6651694E 02	4.7953697E 02	-9.5691049E 01	-1.6131053E 02	6.0429307E 01	-1.6998600E 01	2.1158463E 01	4.3396792E 01
	7	2.4404692E 02	2.9909167E 02	3.0686440E 02	8.3575849E 01	1.3361009E 01	3.8886531E 01	1.5700754E 01	5.8185233E 00	2.2101759E 01
	8	2.6909425E 02	-4.8520759E 02	-8.8171769E 02	2.2063866E 02	-1.0753999E 02	-3.9479746E 01	2.3014909E 01	-7.2021204E 01	-5.9807073E 01
	9	-2.3577311E 02	-3.0989546E 02	-2.8149716E 02	-5.4820073E 01	-2.4657164E 00	-4.6885004E 01	-1.6194225E 01	-5.7258630E-01	-2.4049563E 01
	10	-2.1793283E 02	4.2202014E 02	7.2903955E 02	-2.0724807E 02	-2.7596089E 02	3.2335802E 01	-1.8904032E 01	8.5318733E 01	4.0699290E 01
	11	8.2213799E 01	1.1539116E 02	9.4514658E 01	1.5967091E 01	-1.8479408E 00	1.9970889E 01	6.3926995E 00	-8.7065423E-01	3.2674674E 00
	12	6.8363263E 01	-1.4097802E 02	-2.3502161E 02	6.9601694E 01	9.3408277E 01	-9.5216227E 00	5.8498392E 00	-3.4088746E 01	-1.1174006E 01
II	13	-3.1111364E-03	3.7130803E-02	1.9675085E-01	-5.0505439E-03	-1.2273588E-02	1.3178464E-02	1.6902823E-02	5.8020303E-02	1.7616392E-02
	14	1.6325917E-01	1.8778868E-02	9.3292036E-01	-1.6070859E-01	8.7038947E-03	-5.1076926E-02	-3.6166594E-02	7.7700138E-02	1.2626209E-02
	15	8.4895009E-02	1.6703957E-01	5.6371628E-01	-7.8161190E-01	-2.1178115E-01	-7.5652730E-02	-5.8177151E-01	-2.0731304E-01	1.5873119E-01
	16	-2.2138880E 00	-1.7505902E 00	-4.3399359E 00	-2.9331796E 00	-1.0625864E 00	-2.2105381E-01	1.1224701E-01	3.3872981E-01	-6.4089479E-01
	17	-3.4436243E 00	-4.2805589E-01	-5.5520107E 00	1.4317647E 00	-5.8054690E-01	5.0936288E-02	-8.5566167E-01	-2.5461736E 00	-2.7249219E-01
	18	-6.3044809E 00	-4.1527466E 00	-1.4433322E 01	6.3551247E-02	-4.7390084E-01	1.9277136E 00	1.3674149E-02	-6.8774269E-01	-1.5946826E-01
	19	9.4741756E 00	-7.0112568E-01	-6.4495611E 00	6.6331400E 00	2.4833393E 00	2.2312573E 00	9.4732879E 00	2.6297924E 00	-4.3545650E 00
	20	5.3695678E 01	4.1721454E 01	7.3073733E 01	4.4706221E 01	1.5405267E 01	1.9594241E 00	-2.0121971E 00	-3.5924106E 00	1.0616151E 01
	21	2.8898525E 01	8.5815079E 00	2.0460920E 01	-1.0972059E 01	8.5515375E 00	-6.0884259E-02	5.1972723E 00	1.8780771E 01	2.8020379E 00
	22	4.1568152E 01	2.7724554E 01	5.2268417E 01	1.0525436E 01	-1.7446531E-01	-9.6858301E 00	1.7004546E 00	2.0401853E 00	3.1174119E-01
	23	-6.6759263E 01	-1.3742736E 01	7.1872261E 00	-2.4165373E 01	-1.3928000E 01	-1.2488171E 01	-4.0000953E 01	-7.5834179E 00	2.8713200E 01
	24	-3.0254492E 02	-2.2050830E 02	-3.2427014E 02	-2.2153109E 02	-7.2031055E 01	-9.1201950E 00	6.8865361E 00	1.4343742E 01	-5.6403156E 01
	25	-8.0693480E 01	-3.0917920E 01	-2.3922960E 01	2.7144241E 01	-2.9820130E 01	-9.9416936E-01	-1.1837536E 01	-5.0388902E 01	-9.0142479E 00
	26	-9.0028732E 01	-7.4822660E 01	-4.6570795E 01	-3.5693906E 01	1.2564252E 01	1.6976886E 01	-8.0941546E 00	-2.9120058E 00	8.2261455E-01
	27	1.8322586E 02	7.4178706E 01	2.0350389E 01	1.1434115E 01	3.5150222E 01	2.8350758E 01	7.0453454E 01	1.4433924E 01	-7.3225793E 01
	28	7.1606172E 02	4.6303975E 02	5.5923265E 02	4.7851028E 02	1.4765211E 02	2.0614948E 01	-9.7447894E 00	-2.4255030E 01	1.2620351E 02
	29	9.5449331E 01	4.4873680E 01	-1.8618713E 01	-2.8297037E 01	3.6382407E 01	2.1944123E 00	1.2057610E 01	5.7705684E 01	1.1656471E 01
	30	7.9885371E 01	8.7358310E 01	-3.9377524E 01	4.0634620E 01	-2.5185323E 01	-9.1314063E 00	1.1454819E 01	1.4857567E 00	-2.6965360E 00
	31	-2.2477637E 02	-1.2156183E 02	-3.3388794E 01	-3.0166474E 01	-3.7465211E 01	-2.6922655E 01	-5.2515637E 01	-9.1215318E 00	8.0893284E 01
	32	-7.4817072E 02	-4.2834302E 02	-3.8988209E 02	-4.7067961E 02	-1.3860741E 02	-2.0481181E 01	7.1520000E 00	1.6027557E 01	-1.2496830E 02
	33	-4.1567624E 01	-2.4490650E 01	6.8800223E 01	1.1489837E 01	-1.3792001E 01	-1.0569404E 00	-4.6937778E 00	-2.3846122E 01	-5.2965726E 00
	34	-2.4788013E 01	-3.5656183E 01	5.1635677E 01	-1.5627101E 01	1.3460686E 01	9.4533720E-02	-5.0045370E 00	1.1467383E-01	1.7655640E 00
	35	1.0185472E 02	6.4728755E 01	1.0147490E 01	5.9756311E 00	1.3459421E 01	1.0428407E 01	1.6053605E 01	1.7803050E 00	-3.2548268E 01
	36	2.8383096E 02	1.4539468E 02	8.1654372E 01	1.7282273E 02	4.6453620E 01	7.3304577E 00	1.9470017E 00	-2.7020821E 00	4.5212071E 01
	37	3.2375675E-02	-6.6594579E-02	-7.3930562E-02	7.7859956E-03	3.8187298E-02	-4.8492348E-03	-1.8654908E-02	7.6901857E-03	2.1804165E-02
	38	4.4887345E-02	2.7694557E-02	-1.4093956E-01	-2.6811135E-02	1.6053300E-02	-6.1489808E-03	2.5583601E-02	7.1855074E-03	-1.4412534E-02
III	39	-2.2243550E-01	7.9965690E-01	1.1528773E-01	7.0264183E-02	1.2777511E-01	-1.6233762E-02	-1.8593028E-02	-2.2310859E-02	-1.1386443E-01
	40	-4.1157782E-01	-4.3945373E-01	-1.4733867E-01	3.1498853E-01	5.3268600E-01	3.0602094E-04	3.5013250E-02	-7.3152581E-04	-1.8216440E-01
	41	-6.0129504E-01	3.0933786E-01	4.0313565E 00	2.5105562E-01	-2.0632316E 00	9.0444803E-03	1.1353041E-02	-6.7762142E-02	4.8694346E-01
	42	-5.4718356E-01	2.0250975E-01	8.6734731E-01	-9.2413288E-01	-1.1436232E-01	1.6831259E-02	7.2831482E-02	-1.9141444E-03	-3.4257892E-01
	43	2.4431573E 00	-8.4940921E-01	-4.2161978E-01	-7.3792610E-01	-1.5175129E 00	1.4394707E-01	2.2094268E-01	1.5382243E-01	2.1043183E 00
	44	3.7672088E 00	2.2253875E 00	1.3474982E 00	-1.3718429E 00	-1.9275214E 00	-1.8869688E-02	1.7885350E-01	-2.1096271E-02	5.4360603E-01
	45	2.0633151E 00	-6.1580197E-01	-8.8650360E 00	-8.6683769E-01	7.3258049E 00	-7.6970087E-03	1.3367833E-01	8.0105853E-02	-1.7723341E 00
	46	1.0412164E 00	-9.8925537E-01	-6.7690841E-01	1.9260939E 00	6.6426865E-01	2.9966173E-03	-1.4545954E-01	1.1798088E-02	2.2463466E 00
	47	-5.4059122E 00	-1.4805479E 00	-2.6571760E-01	1.0363975E 00	2.1299899E 00	-2.0120931E-01	-8.5617251E-01	-1.6829177E-01	-6.0461426E 00
	48	-9.2573766E 00	-4.9787298E 00	-1.2792030E 00	2.2254380E 00	1.7774499E 00		-1.5392106E-01		-2.5987278E-01
	49	-1.7357936E 00	5.7236017E-01	8.0317355E 00	5.0302925E-01	-6.5445791E 00		-2.1109224E-01		1.3832242E 00
	50	-3.8134213E-01	8.5847125E-01		-4.0478348E-01	-9.5221753E-01		6.2926206E-02		-4.0336876E 00
	51	3.3317464E 00	9.8485116E-01		-8.3808469E-01			7.9760529E-01		4.5043299E 00
	52	6.2966958E 00	3.0332794E 00		-1.4950064E 00					

GEOGRAPHICAL VARIATION

Harmonic		5		6		7		8	
	K \ S	9	10	11	12	13	14	15	16
I	0	9.9662231E-02	1.4059346E-01	-1.1039782E-01	2.1836845E-02	-2.3775916E-02	-7.9171870E-02	7.9136678E-02	-5.9442100E-03
	1	-1.4269492E-01	-2.1000813E-02	-1.0450172E-01	-1.0369709E-01	7.9041764E-02	-4.2983212E-02	2.9347622E-02	6.6448063E-04
	2	-3.0921571E-01	-3.0494815E-01	5.1600007E-01	4.8571369E-02	7.1871463E-02	3.6601759E-01	-3.9476996E-01	-2.1168590E-03
	3	1.3709866E-01	3.0373425E-02	1.1369207E-01	1.0064306E-01	-9.2053959E-02	4.1775138E-02	-3.0367931E-02	-6.9653338E-02
	4	2.2238367E-01	2.4358802E-01	-4.1776517E-01	-7.9006805E-02	-5.1274070E-02	-3.0297918E-01	3.4033103E-01	

I - Main latitudinal variation. Mixed latitudinal and longitudinal variation: II - First order in longitude, III - Second order in longitude

Notation: For each entry the number given by the first eight digits and sign is multiplied by the power of ten defined by the last two digits and sign.

PREDICTED COEFFICIENTS D_{sK} DEFINING THE FUNCTION $\Gamma(\lambda,\theta,t)$ FOR MONTHLY MEDIAN f_o F2 (Mc/s)

JUNE 1963

TABLE 2

TIME VARIATION

GEOGRAPHICAL VARIATION

Harmonic		0	1		2		3	
	K \ S	0	1	2	3	4	5	6
I	0	2.9846047E 00	-8.8046694E-02	-2.6862277E-01	-2.1199636E-02	-1.4457365E-01	6.0044436E-03	3.6572681E-03
	1	-5.0063784E-01	-7.6290212E-02	-3.7488598E-01	1.1232397E-01	-2.5740258E-02	6.2078843E-02	5.6396277E-02
	2	1.8502771E 00	3.1752311E-01	2.4262191E 00	9.9083309E-02	1.4307732E-02	-2.2658040E-01	-2.0496999E-01
	3	8.4137349E-01	2.6663426E-01	1.2945747E 00	-6.1639423E-01	1.2368405E 00	-2.3074055E-01	-1.6340036E-01
	4	-5.1402204E 00	-2.0459337E-01	-5.8935226E 00	-1.0148953E 00	1.0050479E 00	9.4708319E-01	6.0485869E-01
	5	-7.0252100E-01	-2.9371185E-01	-2.6497596E 00	9.2280931E-01	-1.9509945E 00	3.4670172E-02	2.0162567E-01
	6	5.6363033E 00	-2.1791823E-02	6.2367183E 00	2.0027740E 00	-1.5045267E 00	-1.4015354E 00	-5.2544436E-01
	7	3.8292232E-01	1.0088166E-01	1.6852026E 00	-4.2250965E-01	9.6300536E-01	-1.8452106E-01	-8.7002819E-02
	8	-2.3883651E 00	3.4345697E-02	-2.5892039E 00	-1.0802364E 00	6.8461233E-01	6.7625800E-01	1.5696290E-01
II	9	1.2544817E-02	1.2852314E-02	2.9715913E-02	-2.3435297E-02	2.1155906E-04	1.4332402E-03	4.2638456E-03
	10	2.4321780E-02	2.1911890E-02	7.5407906E-02	-9.3449736E-03	-2.0795630E-03	-7.5650228E-03	2.2972708E-02
	11	1.2732676E-01	-2.7797083E-02	1.8180996E-01	-4.8089901E-02	-3.6817619E-02	-6.0670912E-03	-6.2273492E-02
	12	-2.0698905E-01	-1.7392792E-01	-5.9754139E-01	4.1333600E-02	-9.2276095E-02	4.3383733E-02	8.2026477E-02
	13	4.4254431E-02	-2.0376800E-01	-3.2239984E-01	8.0263320E-02	-3.2606047E-01	-6.2114836E-04	-2.6605765E-01
	14	-2.7335128E-01	-7.6115391E-01	-6.4916547E-01	1.0526965E-01	-3.1021122E-01	1.6702434E-01	-3.7551470E-01
	15	-7.2362359E-01	1.2639286E-02	-3.0706869E-01	2.1878830E-01	1.4669685E-01	1.7550480E-01	4.5044340E-01
	16	1.5488928E 00	9.5394170E-01	3.4156488E 00	-3.6151982E-01	2.2708260E-01	-4.0122665E-01	-3.7207038E-01
	17	-1.3161847E-01	1.2558659E 00	1.9157996E 00	-3.7090902E-01	1.9629614E 00	2.4292586E-01	1.4941336E 00
	18	4.3828341E-01	4.1495153E 00	2.9053687E 00	-3.1033400E-01	1.9141256E 00	-8.6780713E-01	1.2192219E 00
	19	1.2466856E 00	1.9005159E-02	-1.5409626E-02	-3.5533252E-01	1.2707663E-01	-2.8172073E-01	-9.4509131E-01
	20	-2.9312533E 00	-1.6876523E 00	-5.1424119E 00	1.0048570E 00	8.2283062E-02	8.9478191E-01	4.6148516E-01
	21	1.0559157E 00	-2.6725012E 00	-2.7053389E 00	6.7683600E-01	-3.6781721E 00	-5.4157873E-01	-2.4787099E 00
	22	2.6256208E-01	-7.4462361E 00	-5.7685223E 00	2.8350815E-01	-3.3083349E 00	1.4452663E 00	-1.6611926E 00
	23	-6.0497429E-01	-8.7056484E-02	3.2471066E-01	1.7718636E-01	-3.5072536E-01	9.7987007E-02	6.0858164E-01
	24	1.6711073E 00	1.0074546E 00	2.9167006E 00	-7.9588009E-01	-2.5801870E-01	-5.8724669E-01	-1.6463785E-01
	25	-9.6628070E-01	1.7942738E 00	1.6935262E 00	-3.4668796E-01	2.1491364E 00	2.7213872E-01	1.2611379E 00
	26	-5.7675345E-01	4.2121412E 00	3.2729195E 00	-5.9875280E-02	1.7415306E 00	-7.7082828E-01	8.2007469E-01
III	27	1.4449766E-02	-7.3129424E-03	2.8285532E-02	-6.5126359E-03	1.6237066E-03	-5.5957836E-03	-7.9247389E-03
	28	-6.0268623E-03	-1.8759120E-03	4.7417365E-03	-6.5064171E-03	1.5027262E-02	-2.4613063E-03	1.8606725E-04
	29	-1.4362969E-03	-1.1350380E-01	6.6375435E-04	-9.6650246E-03	-1.5928333E-02	3.9470264E-02	-4.2794055E-03
	30	2.0993976E-03	2.4667502E-02	-6.8907294E-02	2.0909759E-02	2.6412395E-02	1.5431829E-02	4.3180137E-04
	31	-1.3104181E-01	-3.7223690E-04	2.9154513E-03	-5.7752228E-02		1.6941041E-02	1.0117318E-03
	32		9.5583291E-02	-1.0230071E-02	-5.0660560E-03		1.8073043E-03	2.4693773E-03
	33		2.6012231E-01		-1.5078302E-02		-1.0169957E-01	7.2281267E-03
	34						-6.7063709E-04	
	35						-1.3745593E-02	
	36							

GEOGRAPHICAL VARIATION

Harmonic		4		5		6	
	K \ S	7	8	9	10	11	12
I	0	1.9780783E-02	7.0531886E-03	8.4443347E-03	1.1299466E-02	-2.8147691E-03	8.5125544E-03
	1	1.8452392E-02	2.2202710E-02	-3.5465446E-02	-1.2499608E-02	-2.8678856E-03	-1.7787042E-02
	2	-3.2098590E-02	-1.8260167E-02	-3.6797341E-03	-1.7900707E-02	8.3869251E-03	-5.9672219E-03
	3	-1.7256201E-02	-1.5475240E-02	3.5480584E-02	1.4955502E-02	1.2369826E-03	1.6962022E-02

I - Main latitudinal variation. Mixed latitudinal and longitudinal variation: II - First order in longitude, III - Second order in longitude.

Notation: For each entry the number given by the first eight digits and sign is multiplied by the power of ten defined by the last two digits and sign.

PREDICTED COEFFICIENTS D_{SK} DEFINING THE FUNCTION $\Gamma(\lambda,\theta,t)$ FOR MONTHLY MEDIAN M(3000)F2

JUNE 1963

JUNE 1963 UT=00

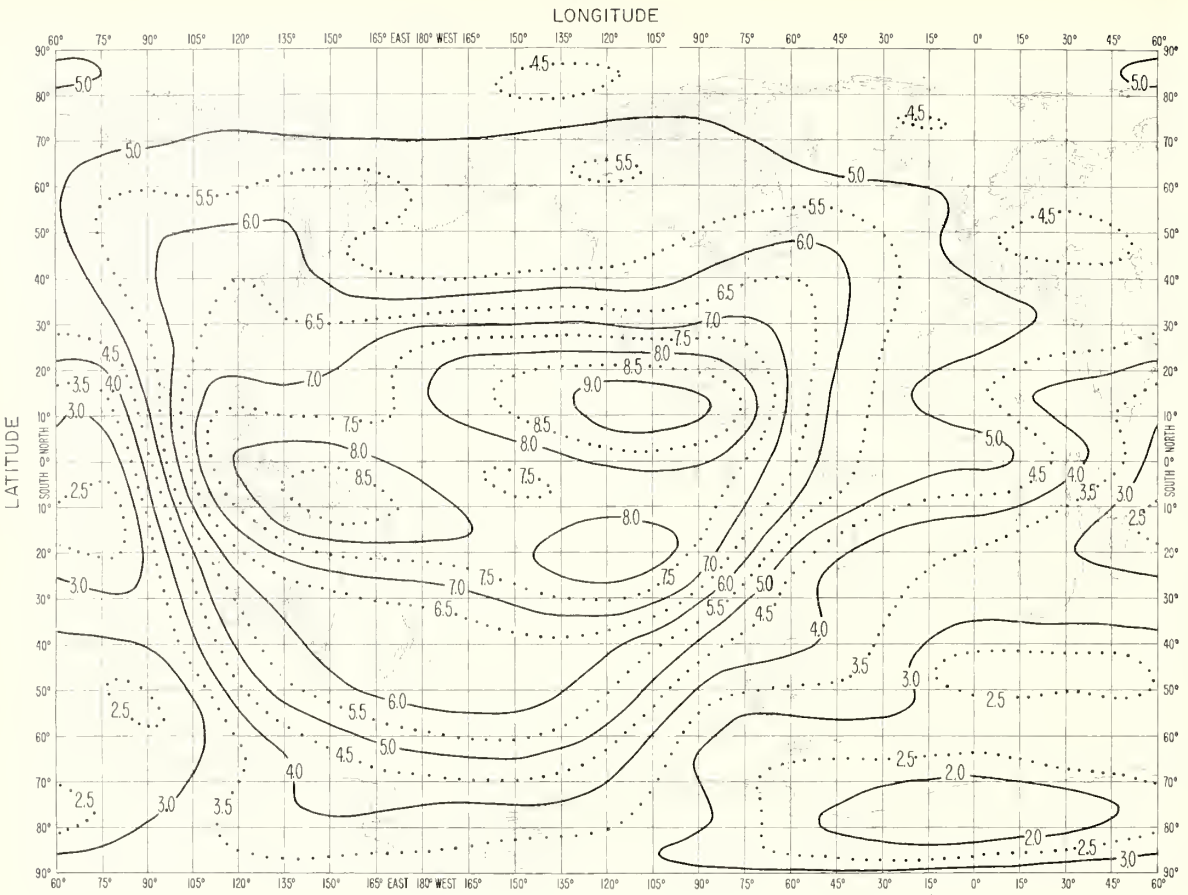

FIG. 1A. PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

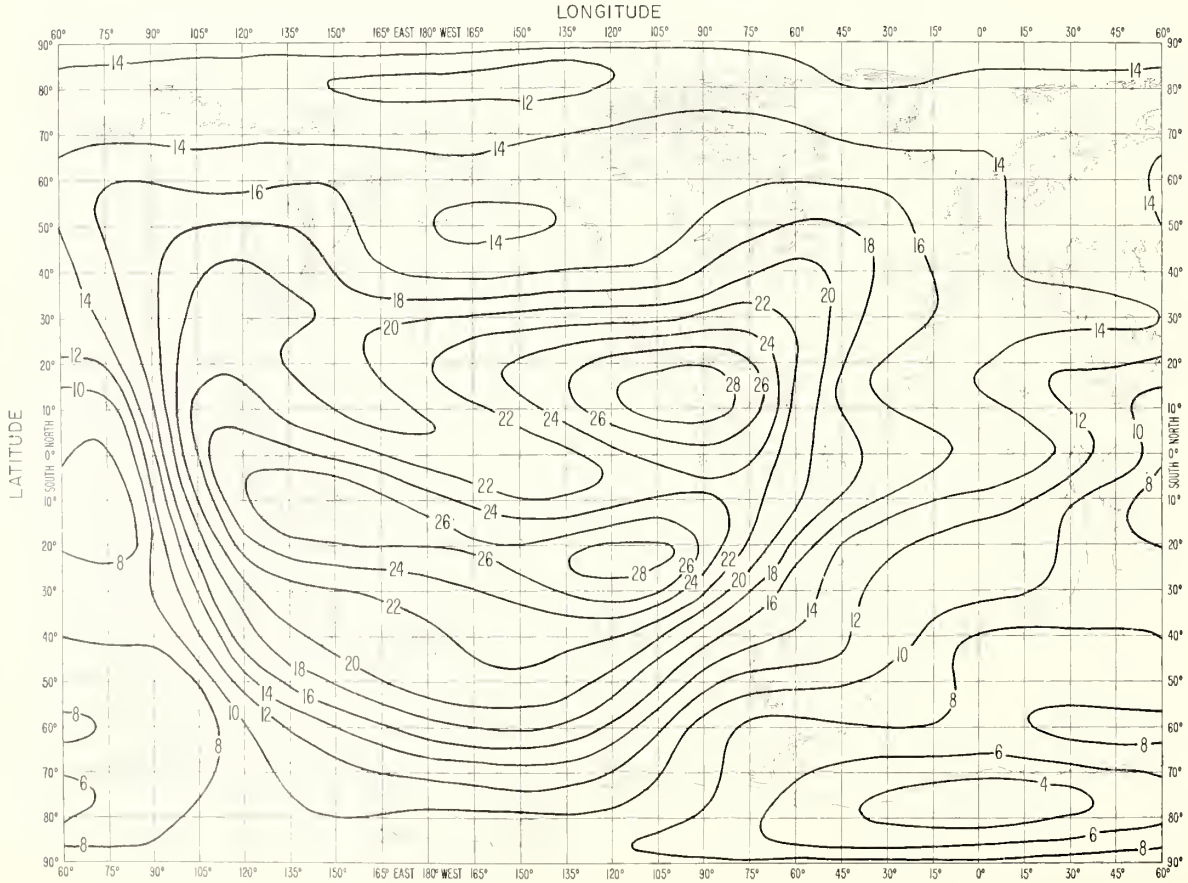

FIG. 1B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

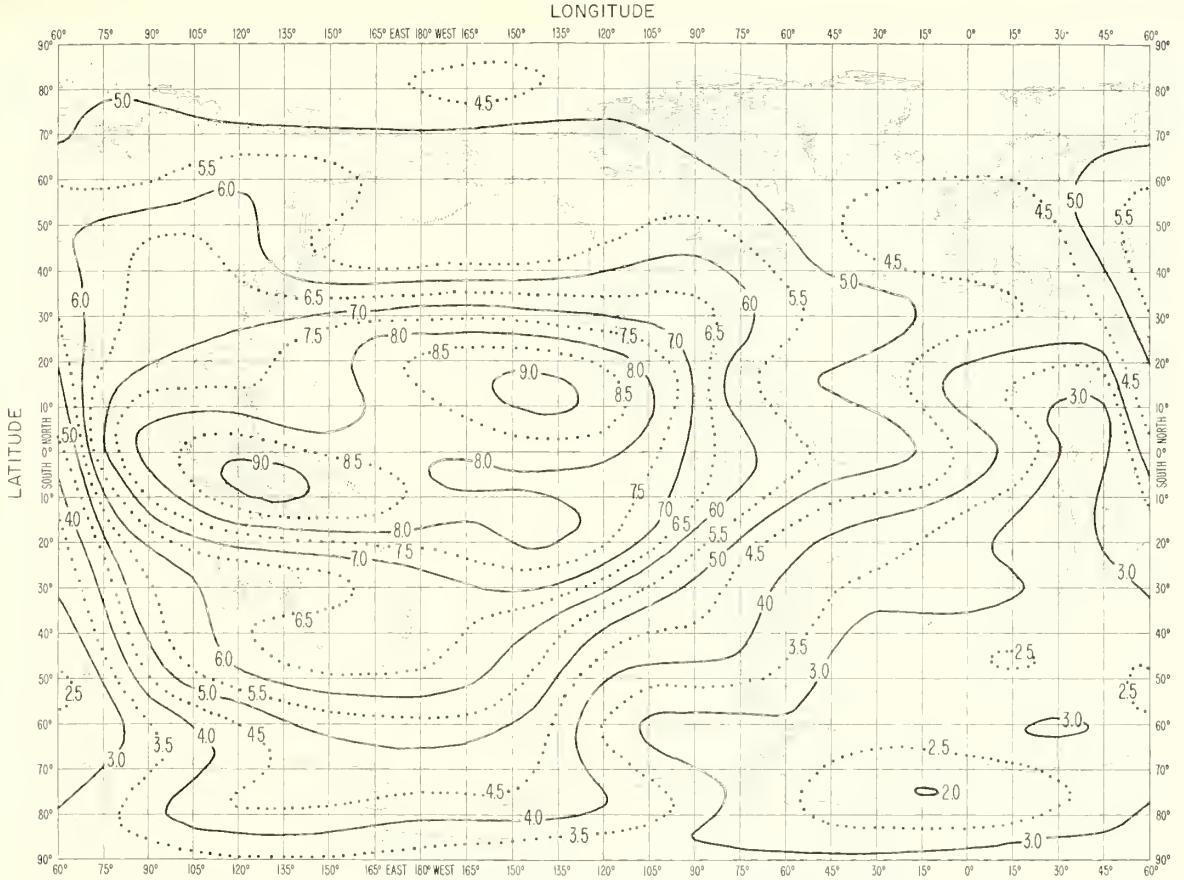

FIG. 2A. PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

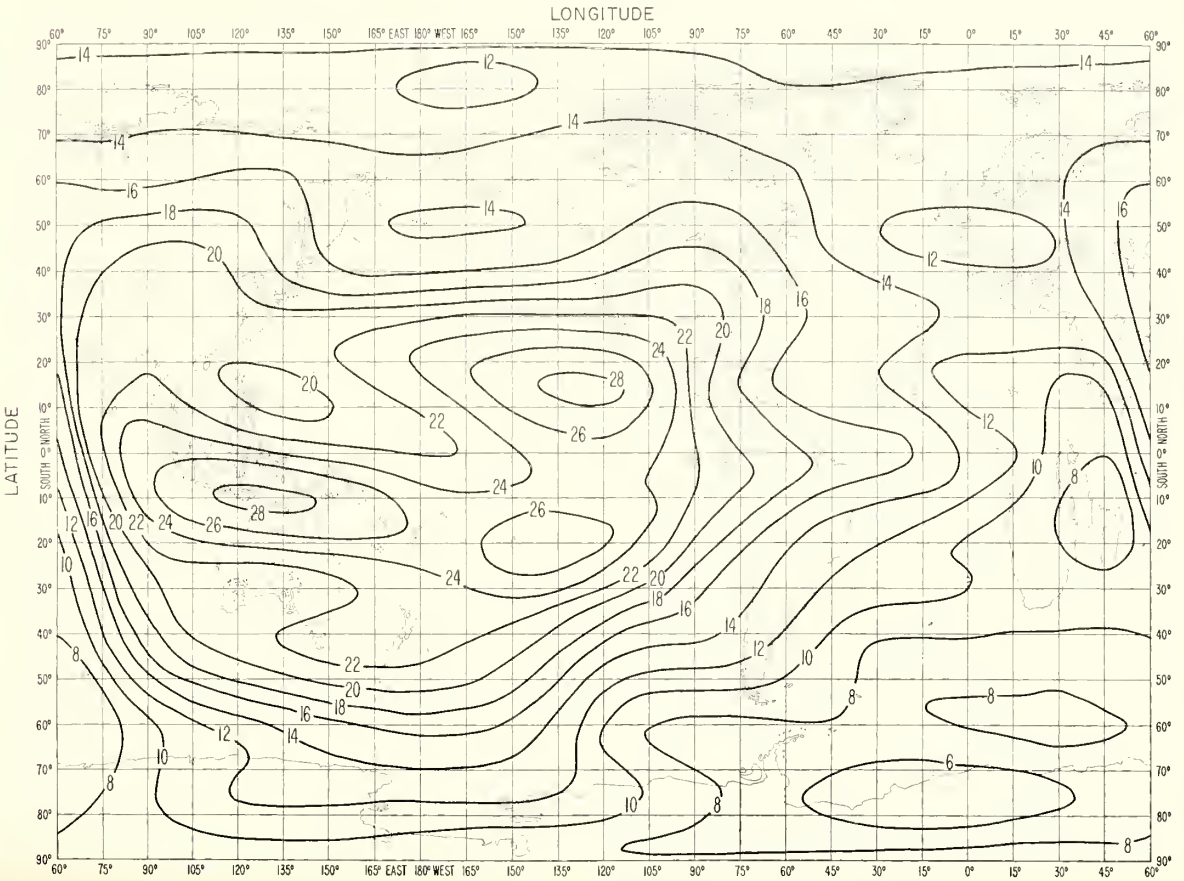

FIG. 2B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

JUNE 1963 UT=04

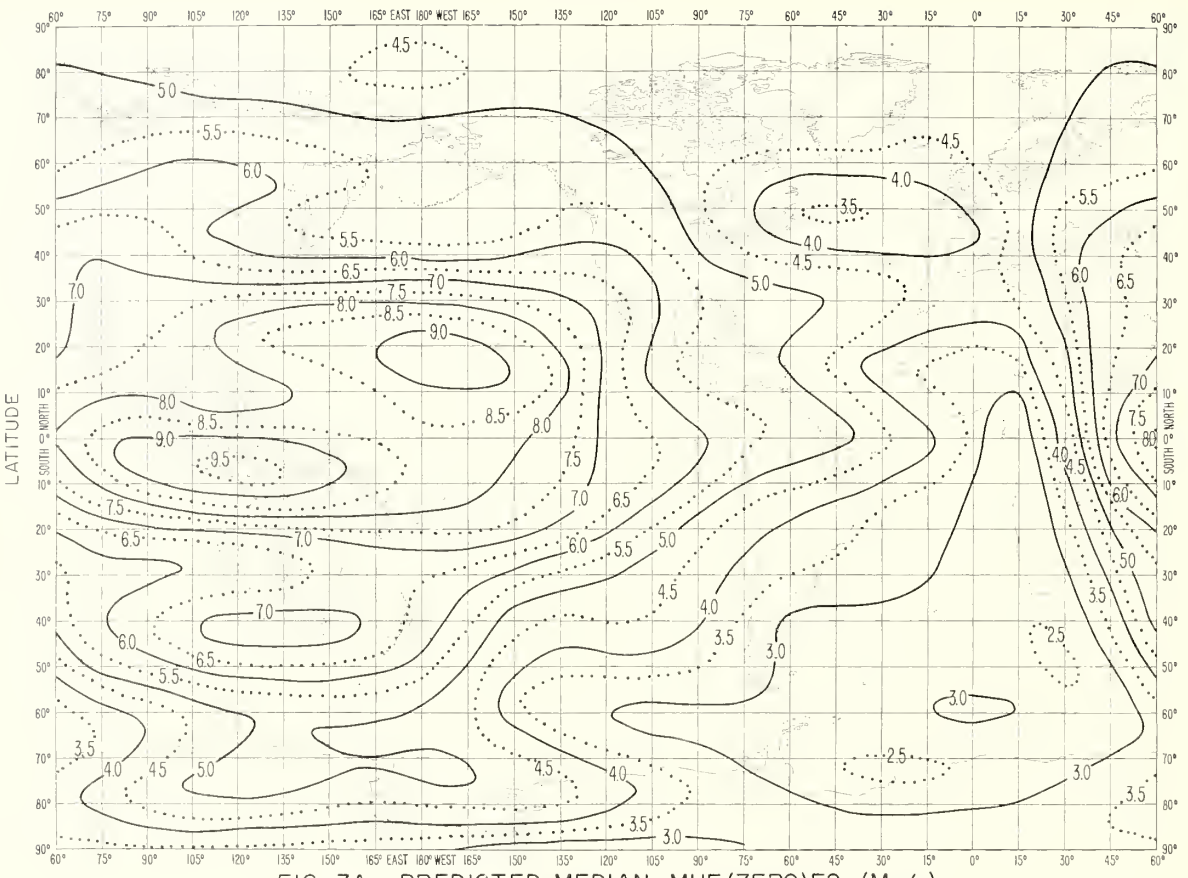

FIG. 3A. PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

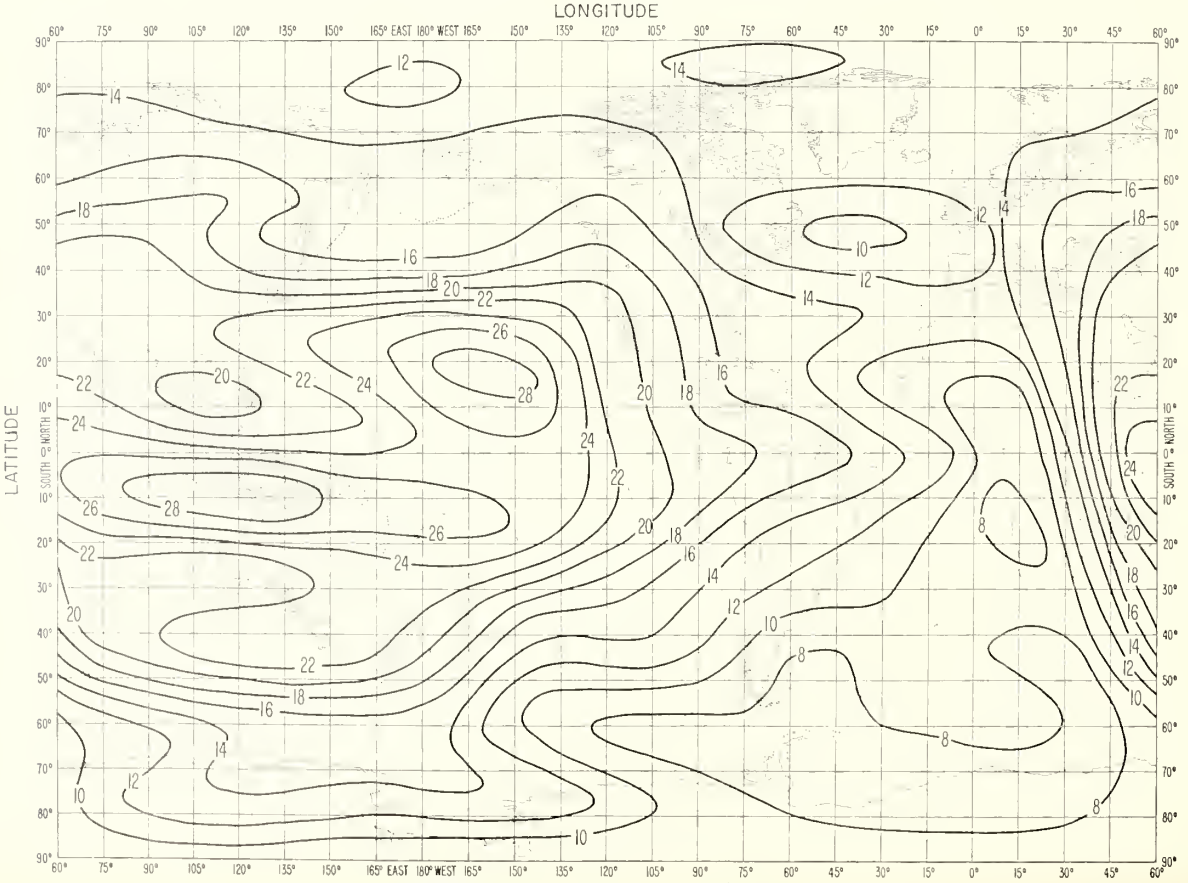

FIG. 3B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

JUNE 1963 UT=06

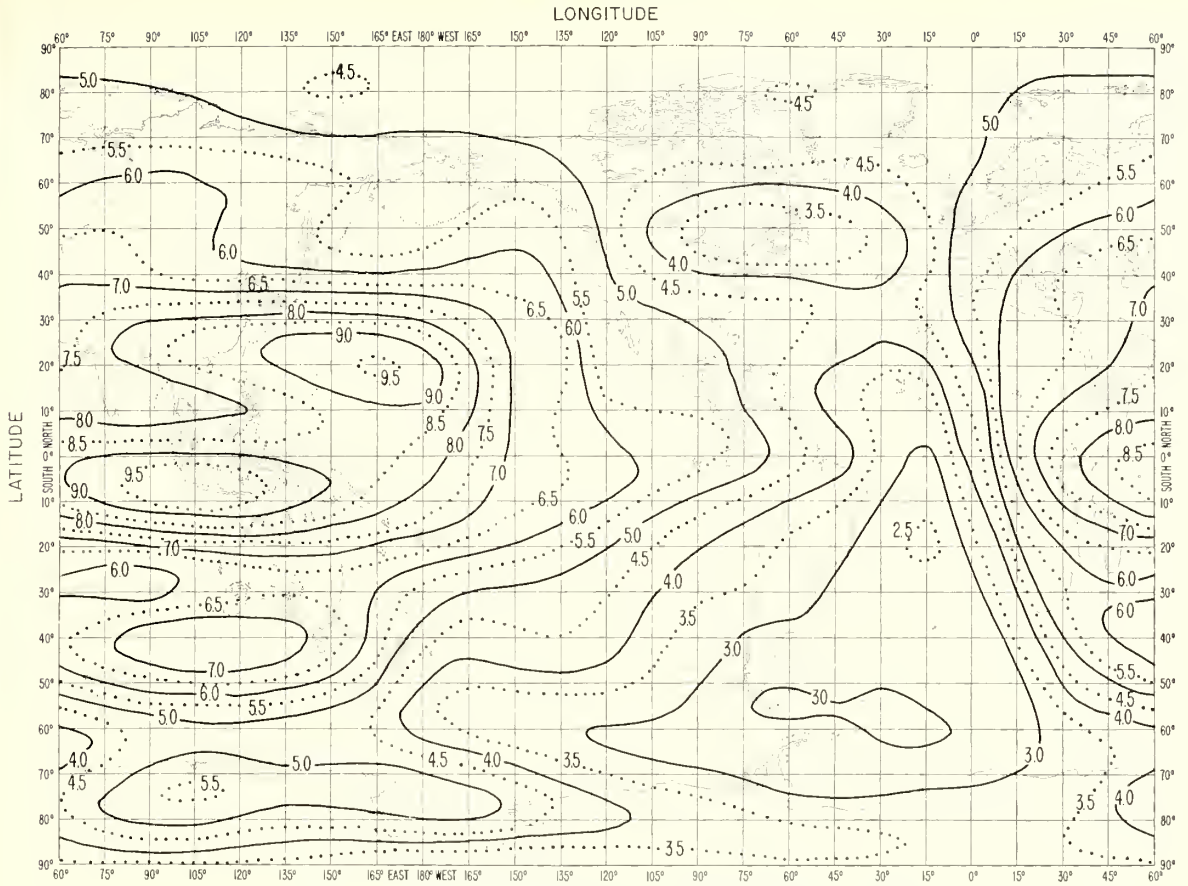

FIG. 4A. PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

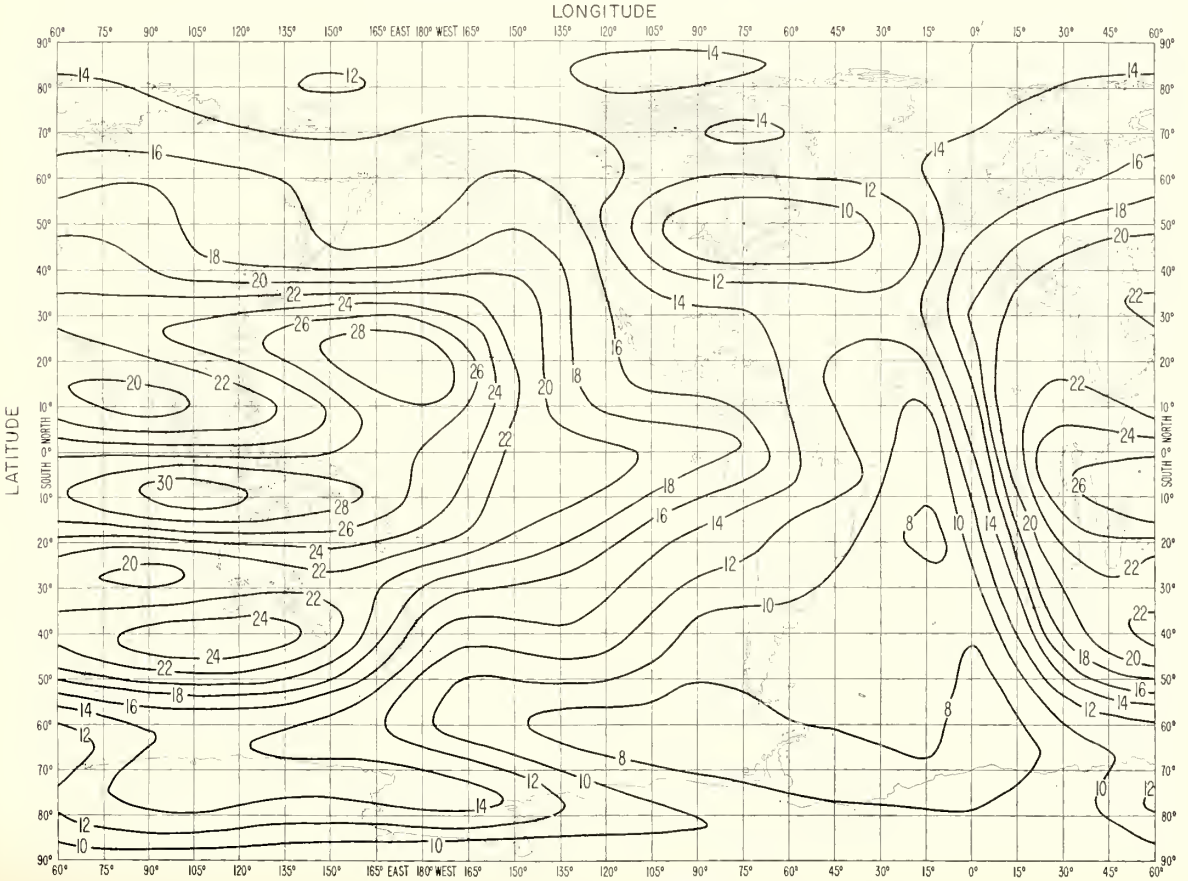

FIG. 4B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

JUNE 1963 UT=08

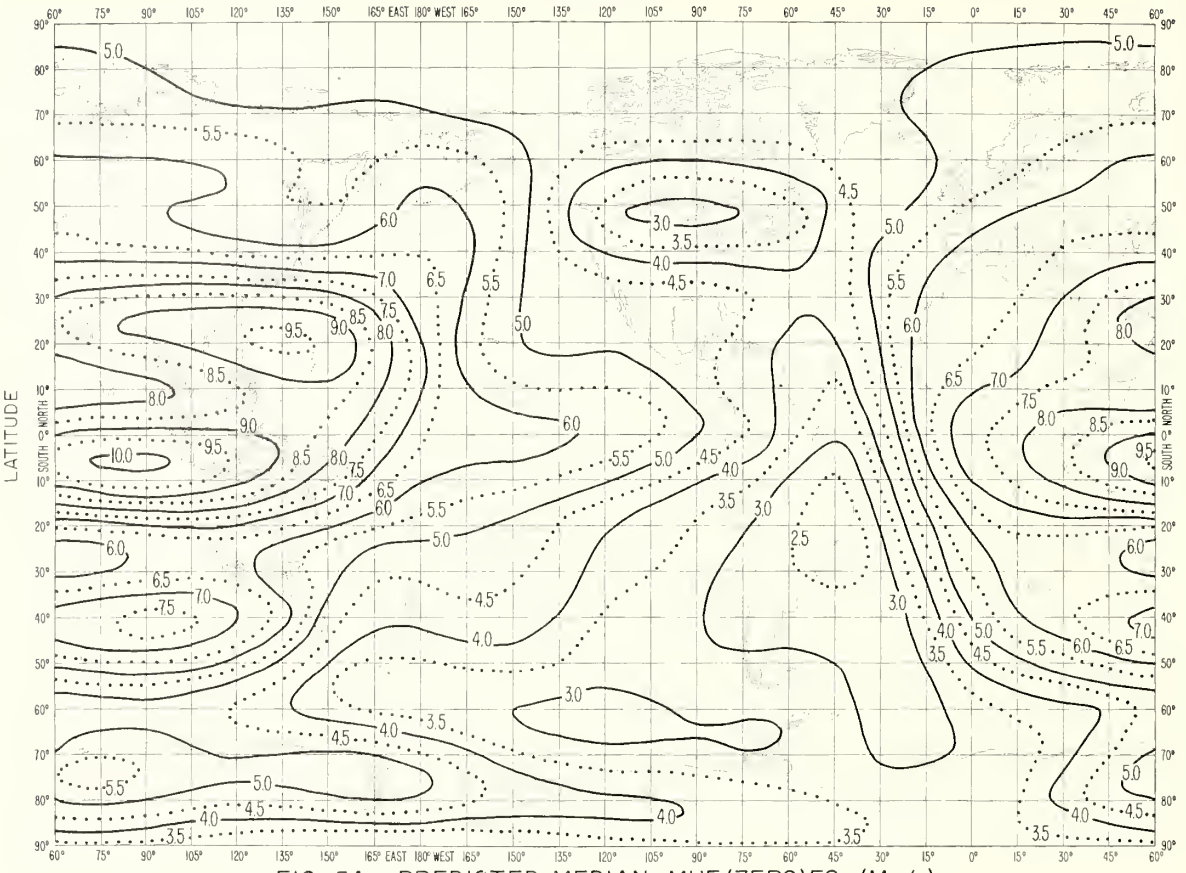

FIG. 5A PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

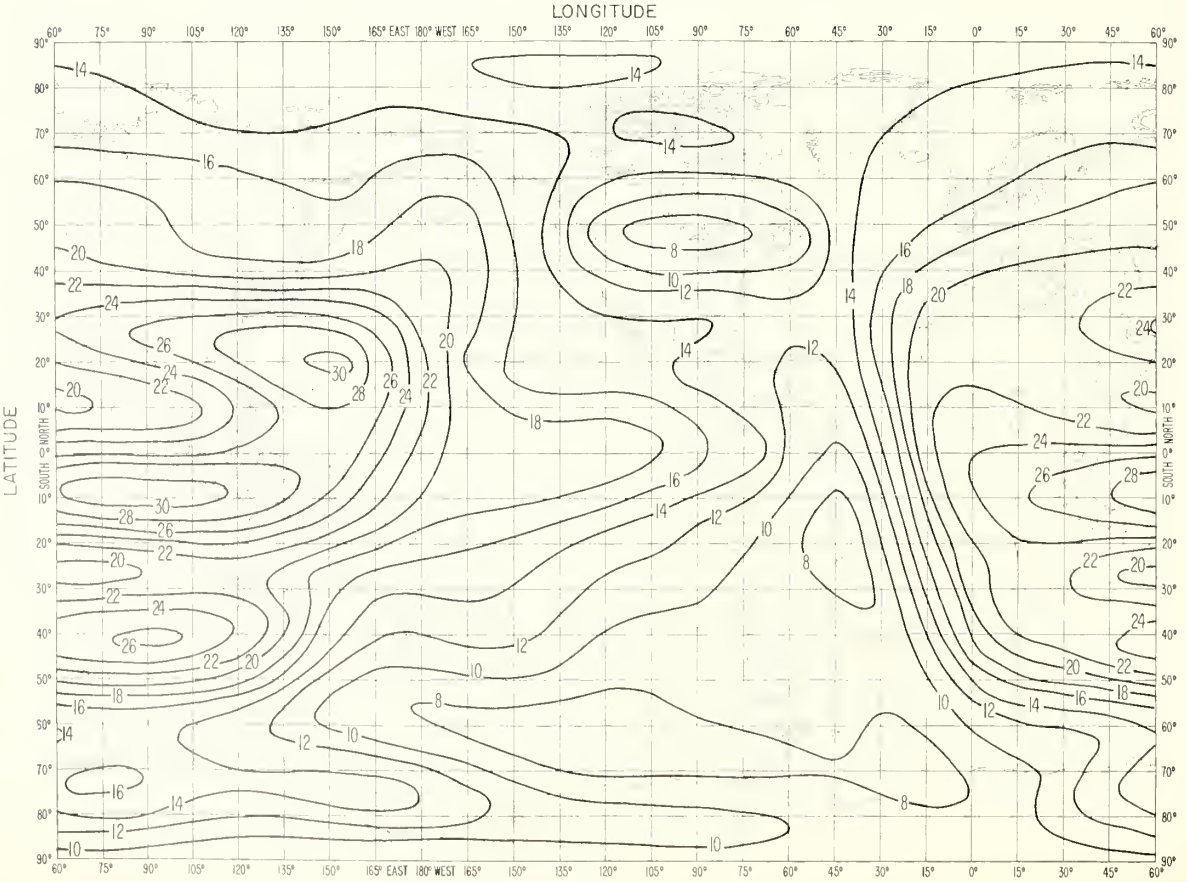

FIG. 5B PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

JUNE 1963 UT = 10

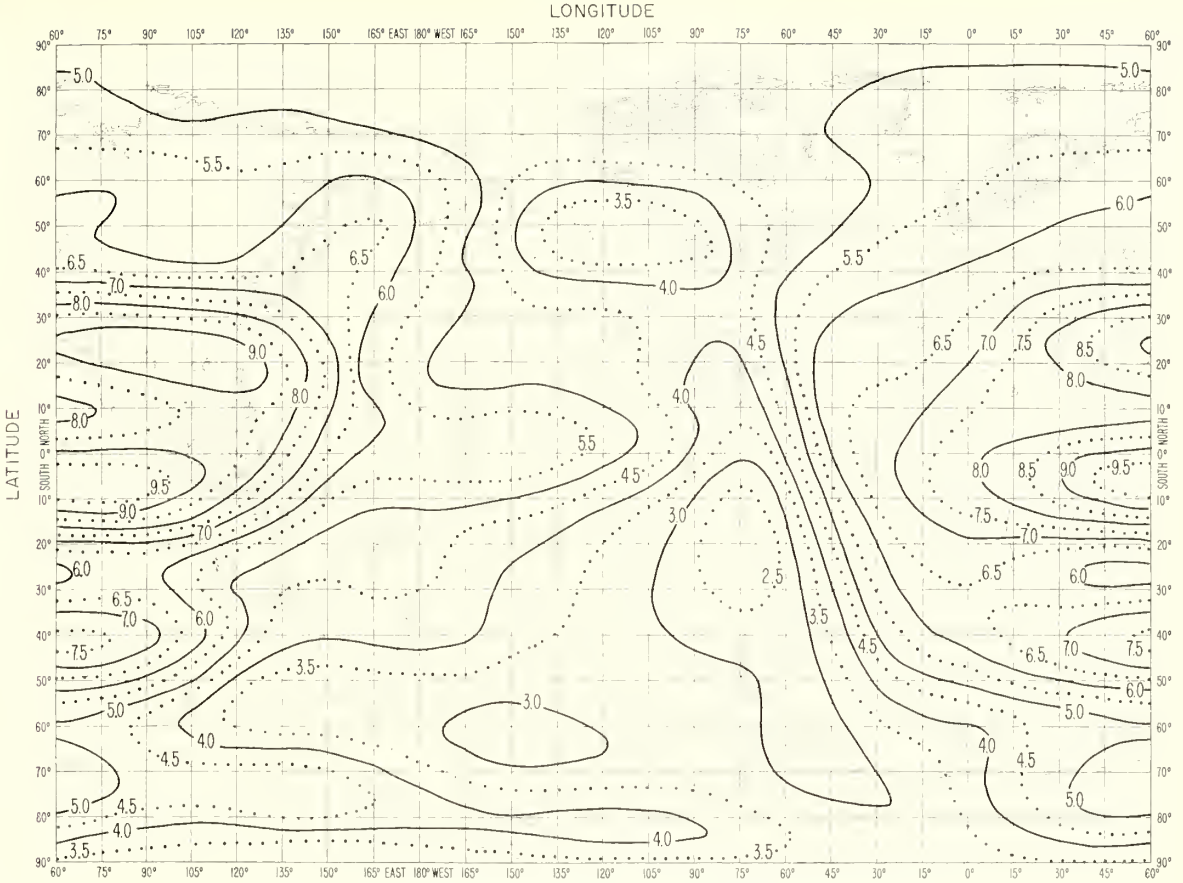

FIG. 6A PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

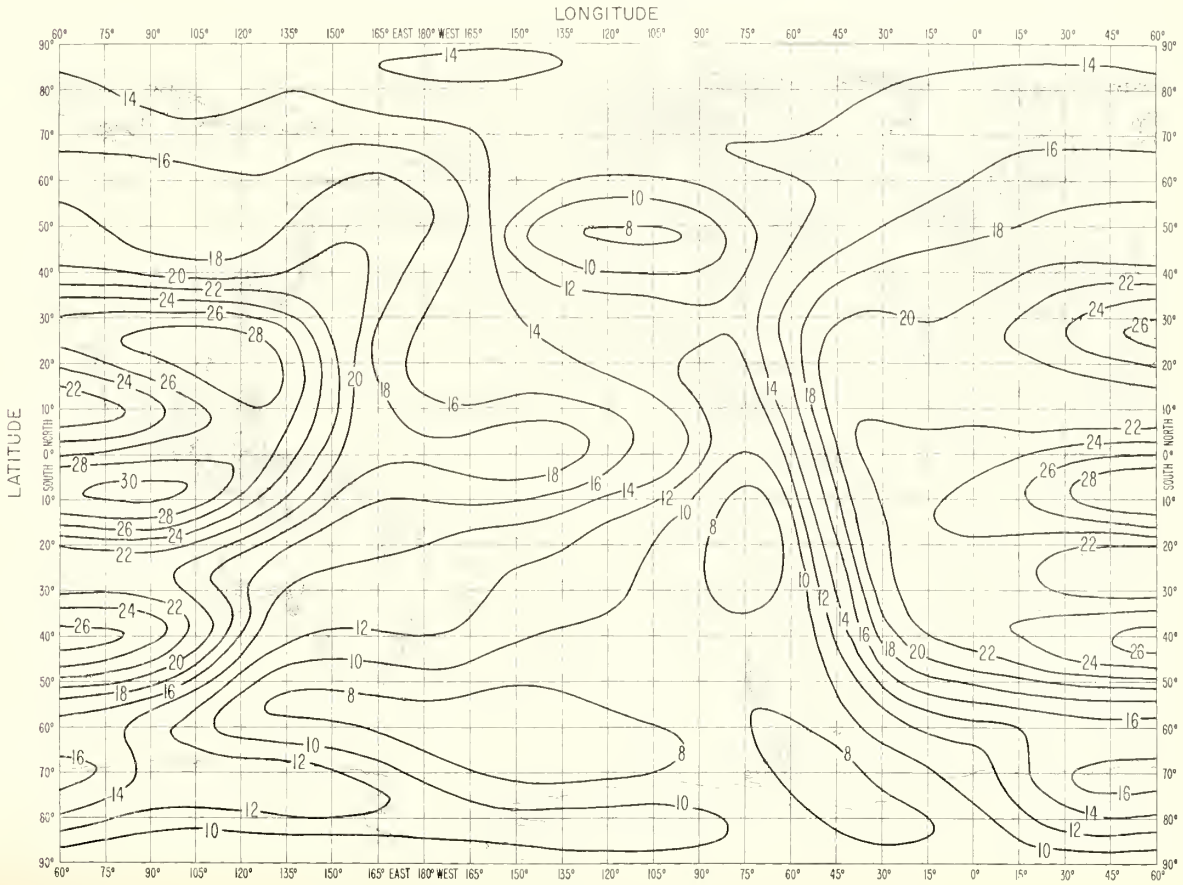

FIG. 6B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

JUNE 1963 UT=12

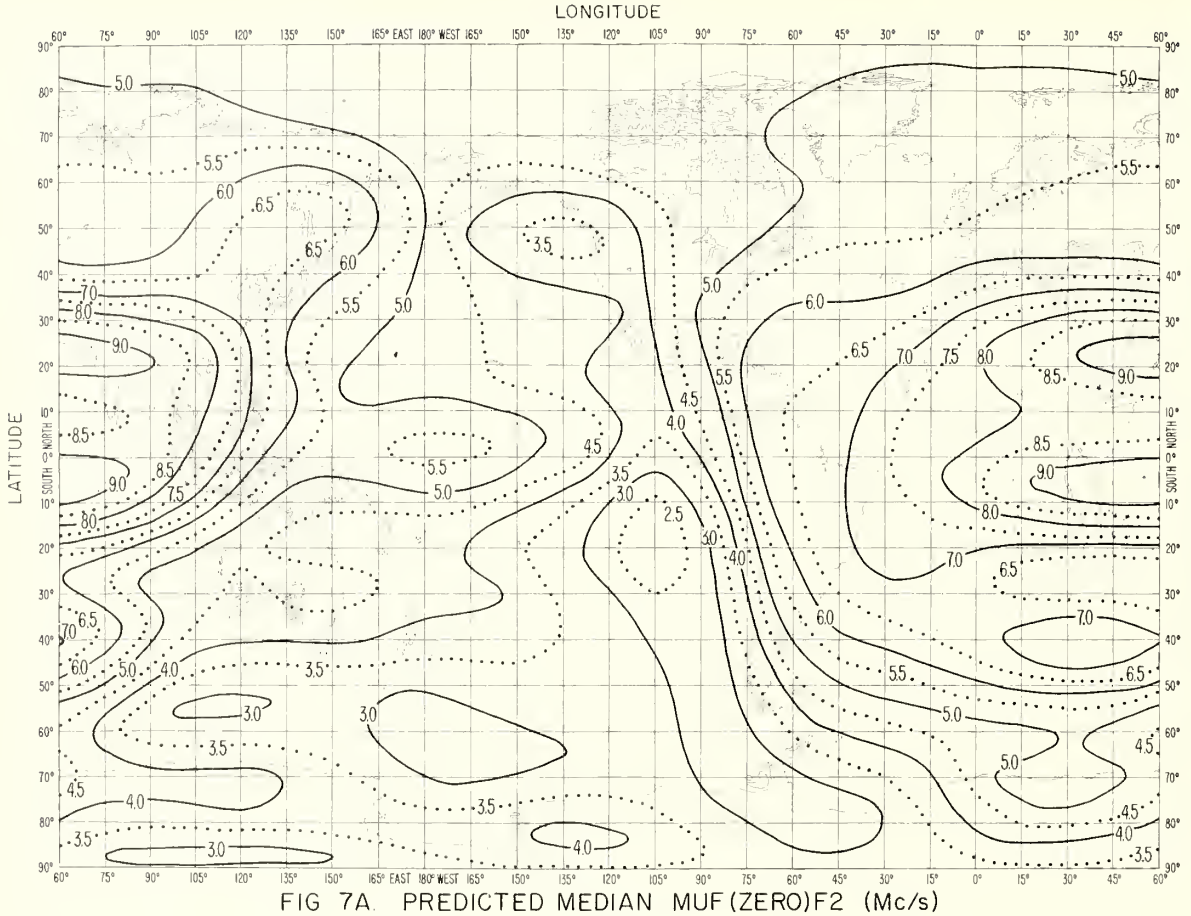

FIG 7A. PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

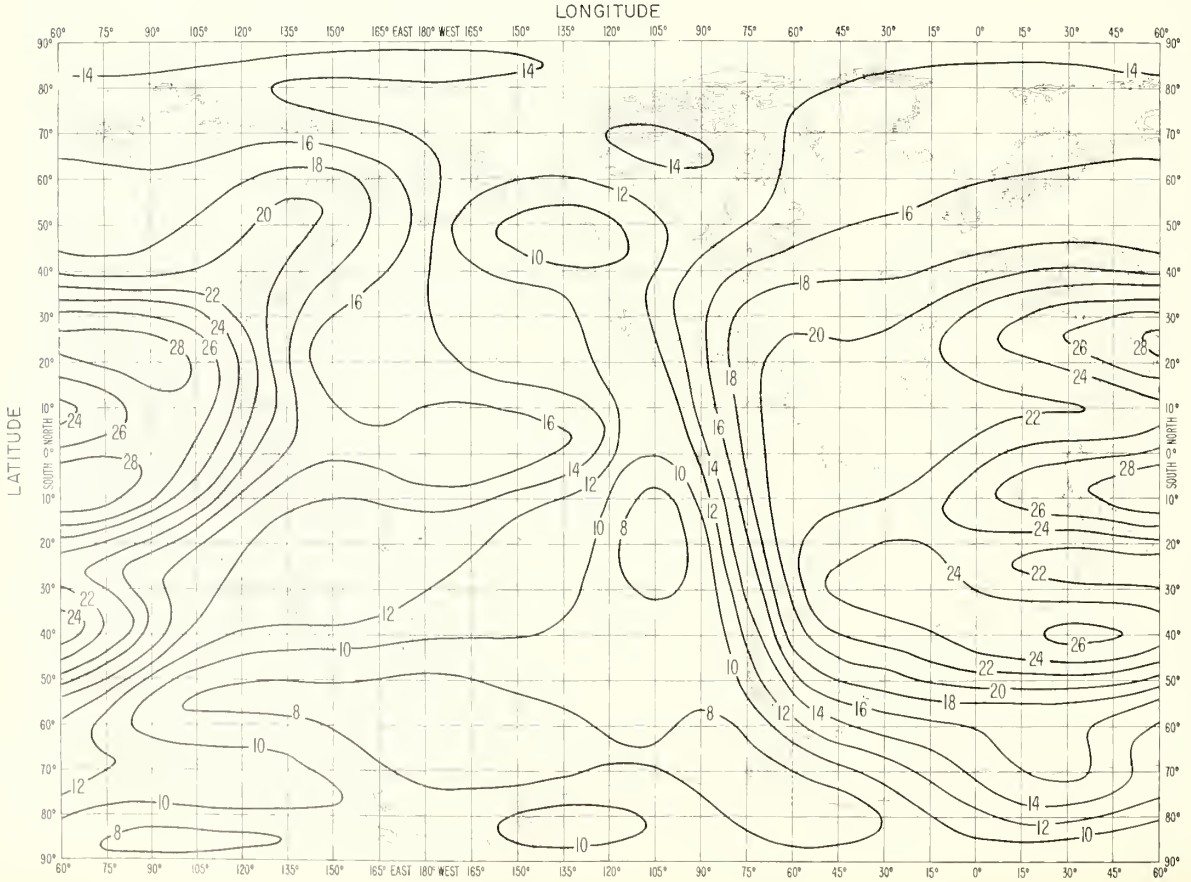

FIG. 7B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

JUNE 1963 UT = 14

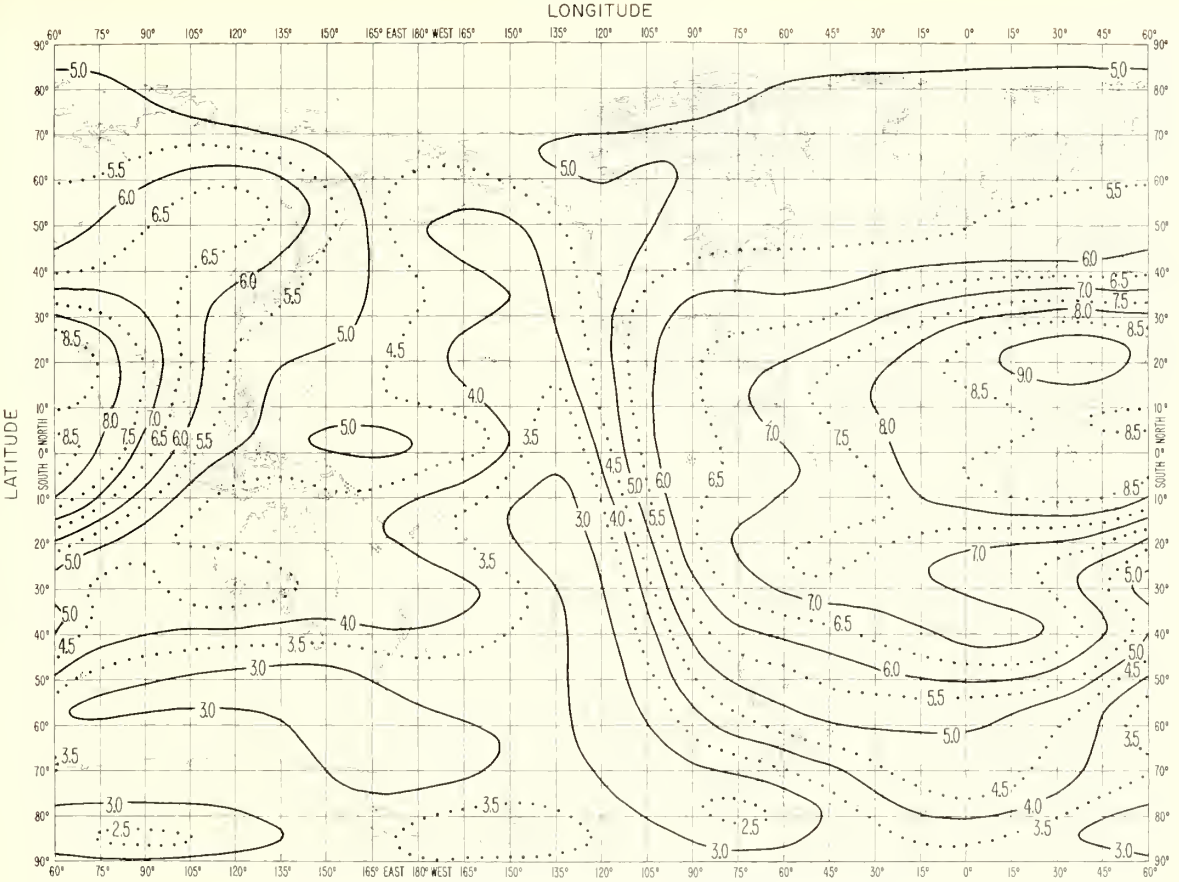

FIG. 8A PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

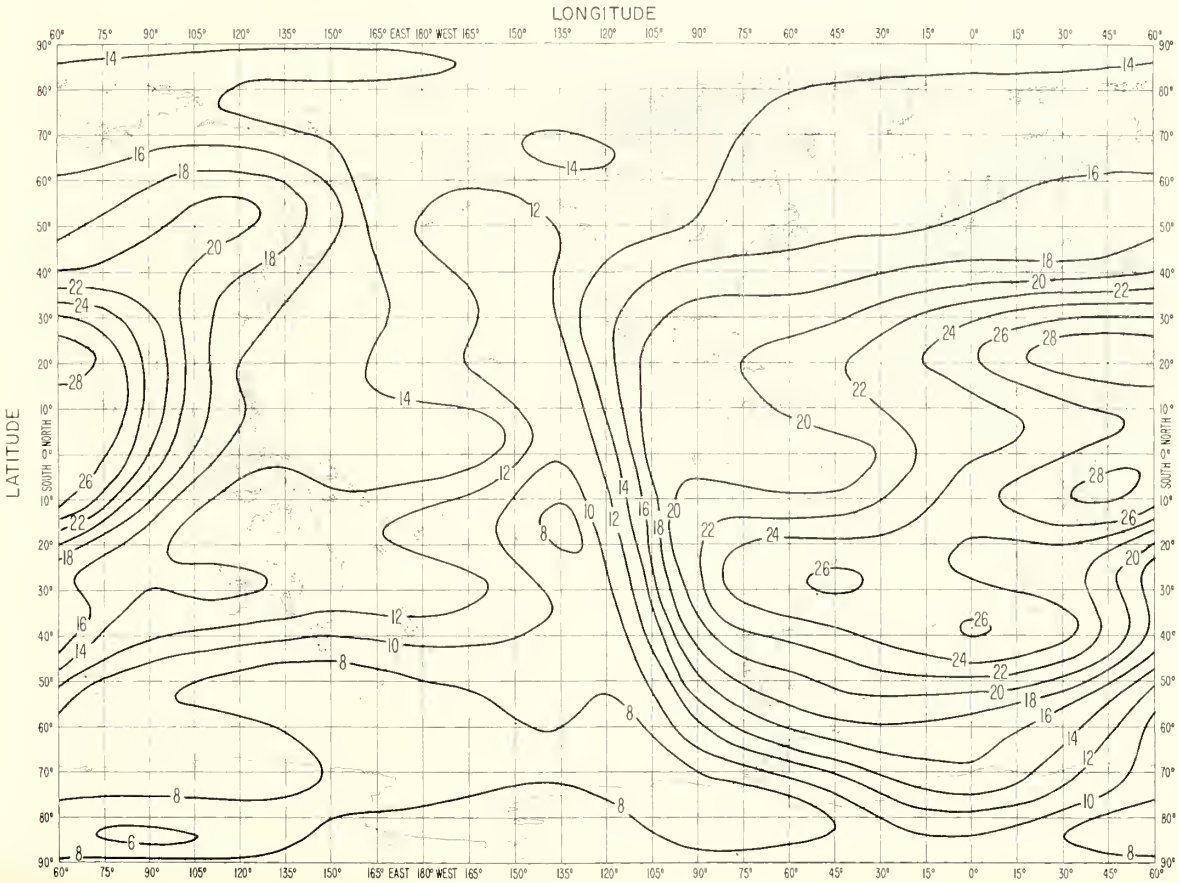

FIG. 8B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

JUNE 1963 UT=16

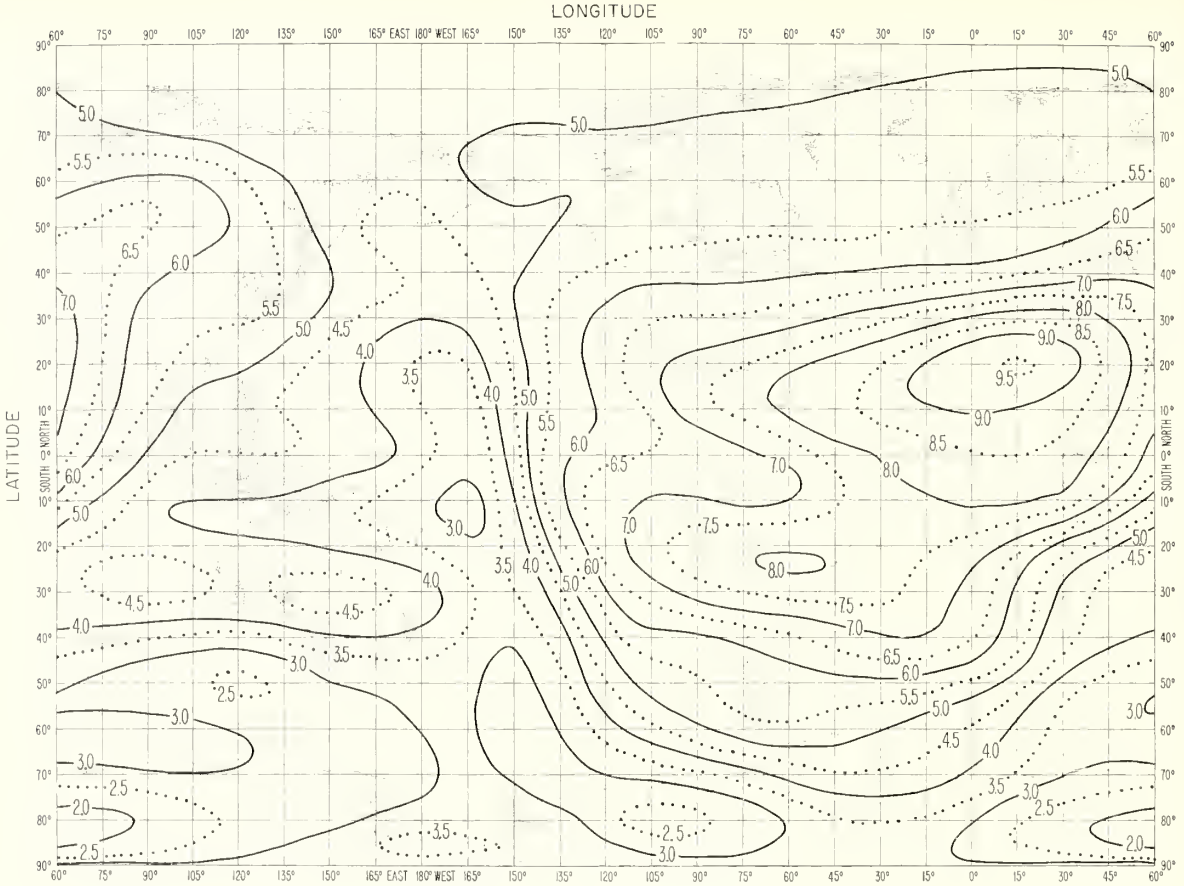

FIG 9A PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

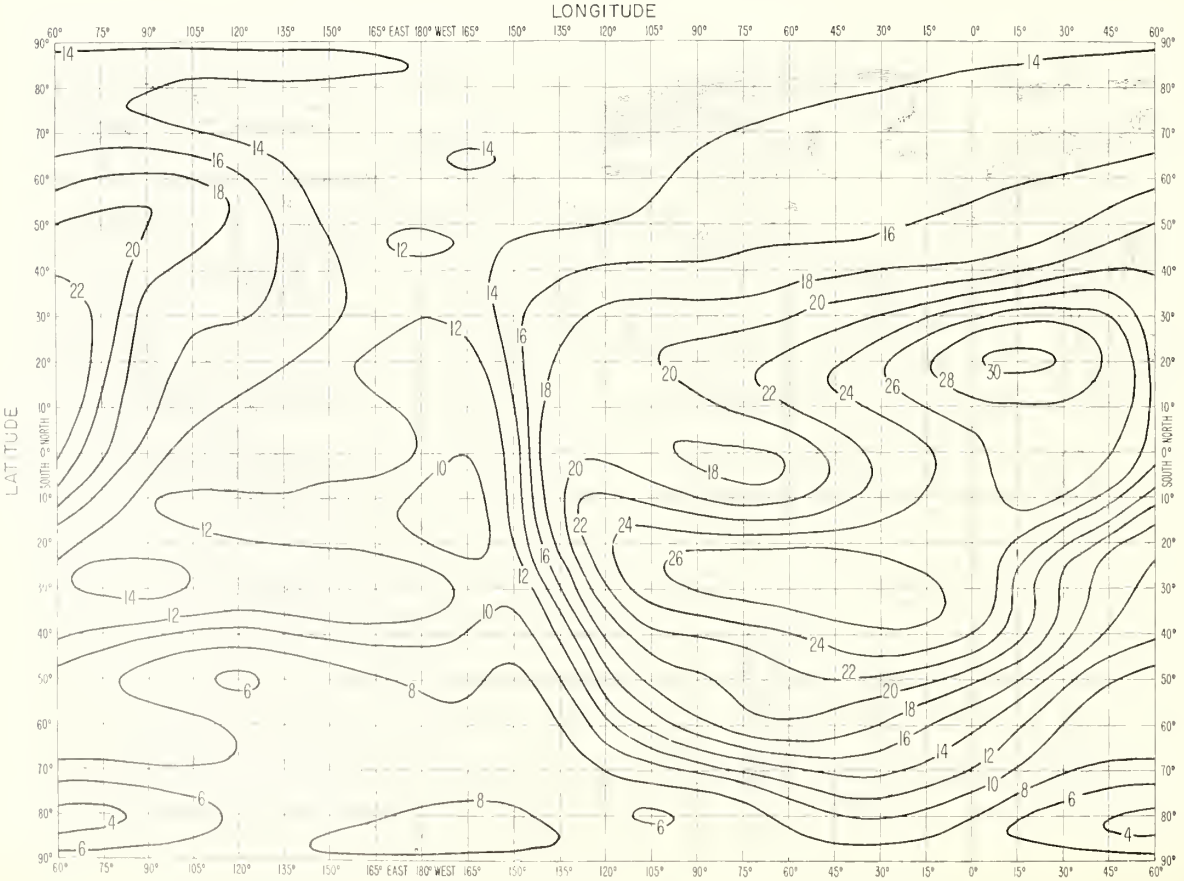

FIG. 9B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

JUNE 1963 UT = 18

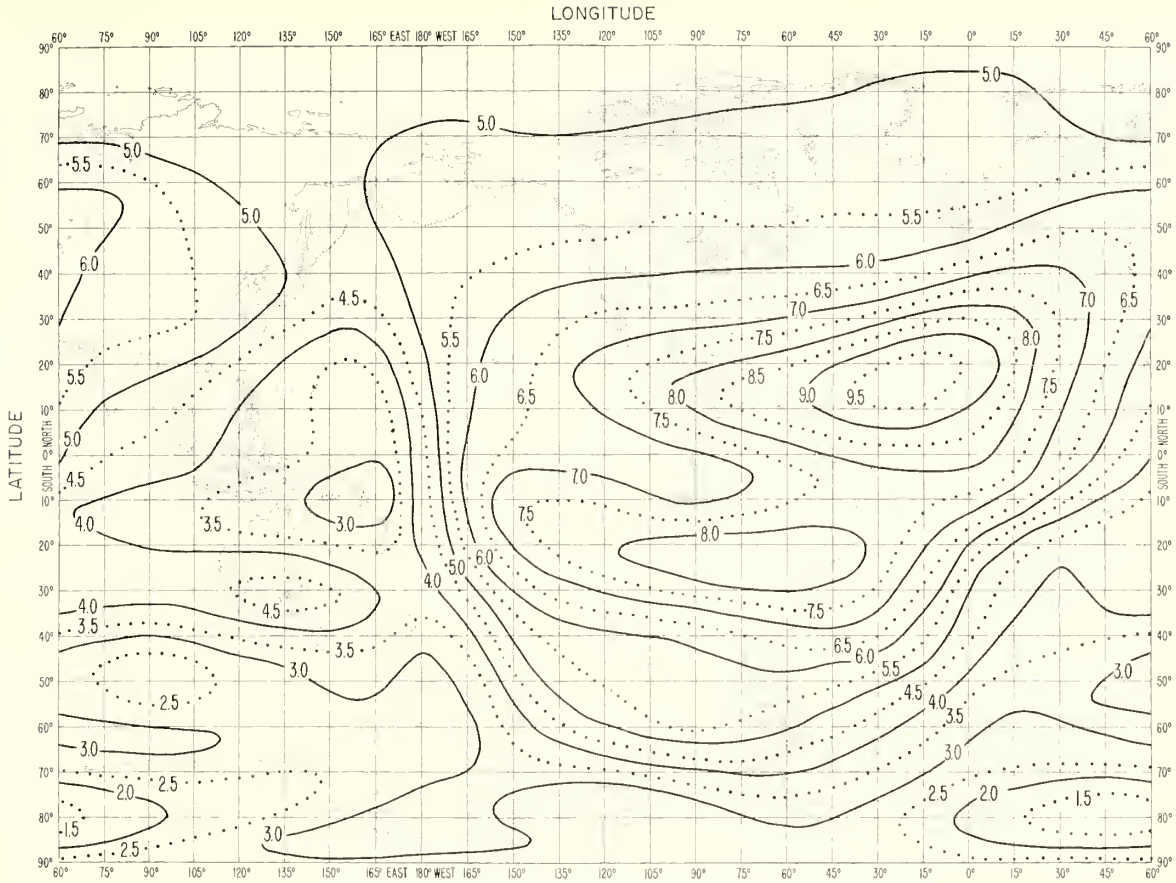

FIG 10A. PREDICTED MEDIAN MUF (ZERO) F2 (Mc/s)

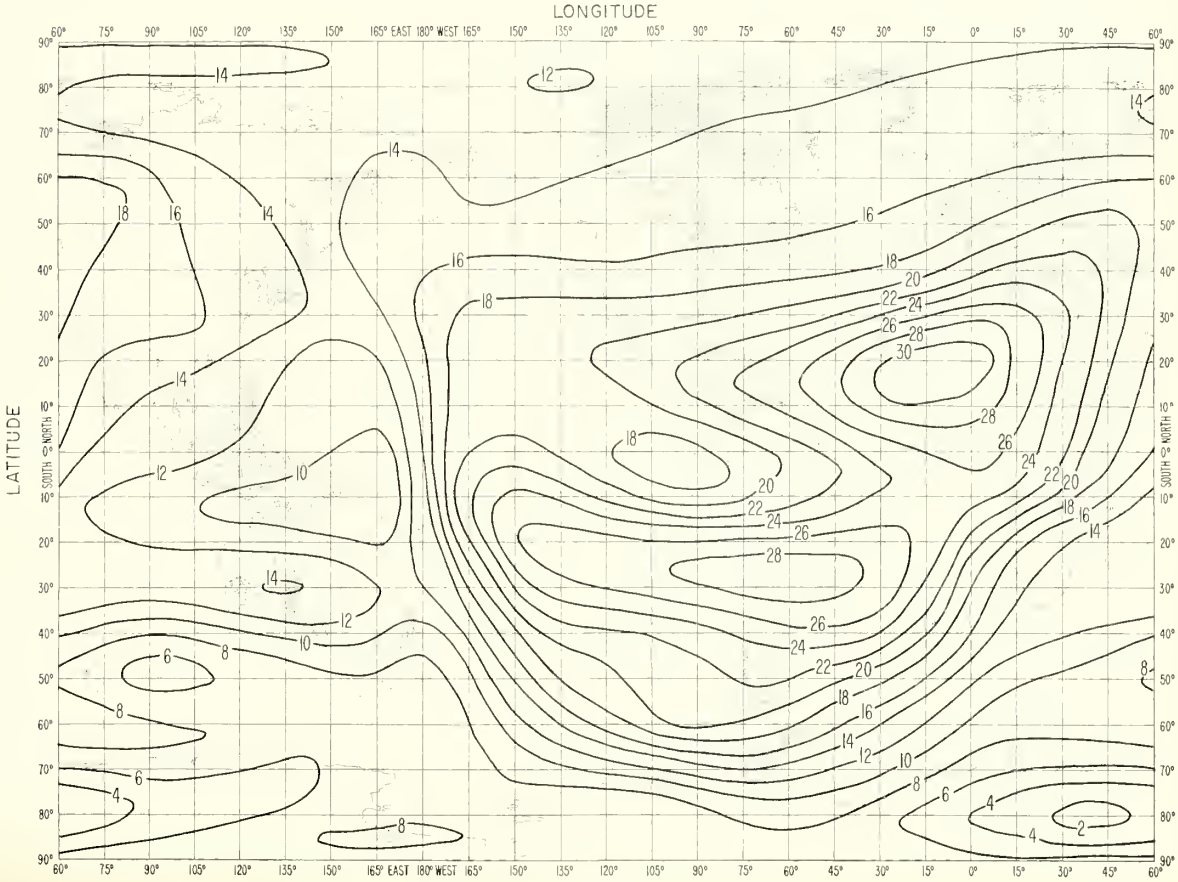

FIG. 10B. PREDICTED MEDIAN MUF (4000) F2 (Mc/s)

JUNE 1963 UT=20

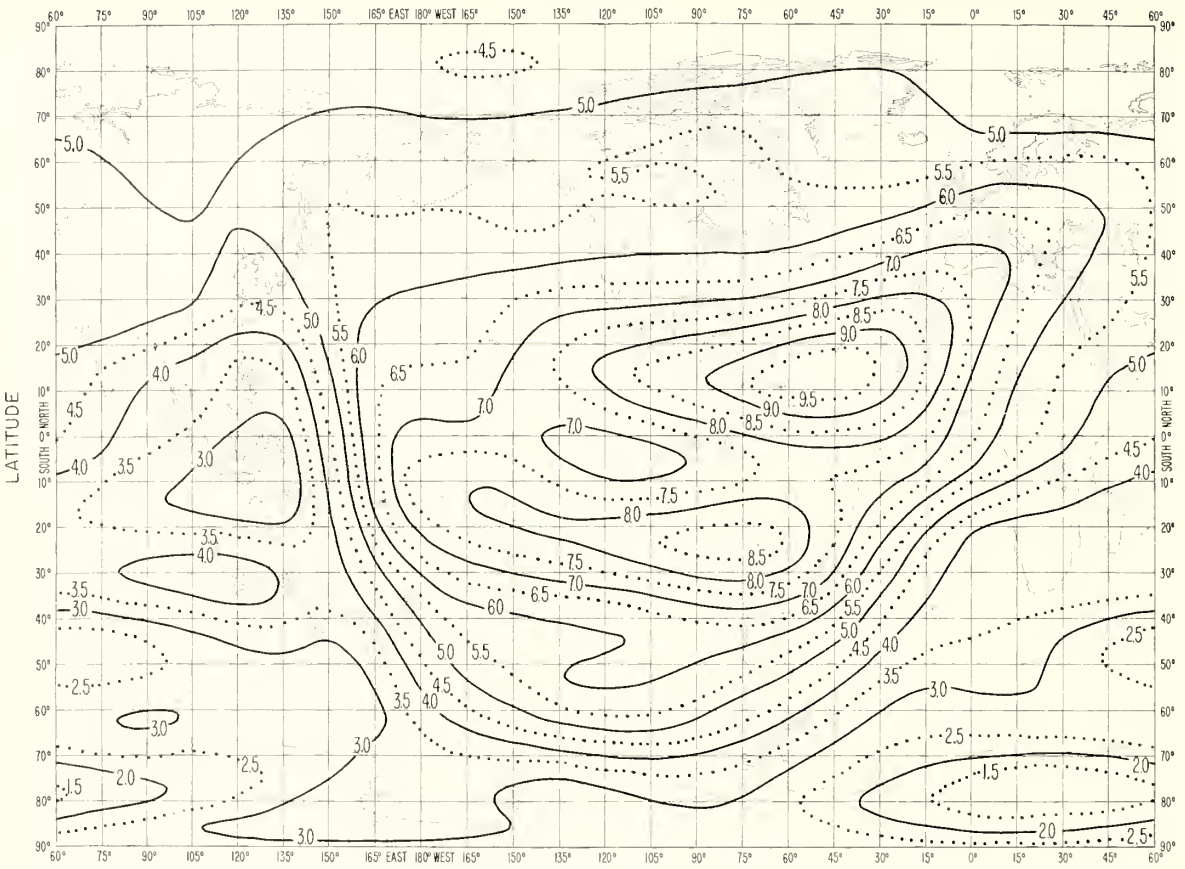

FIG. IIA. PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

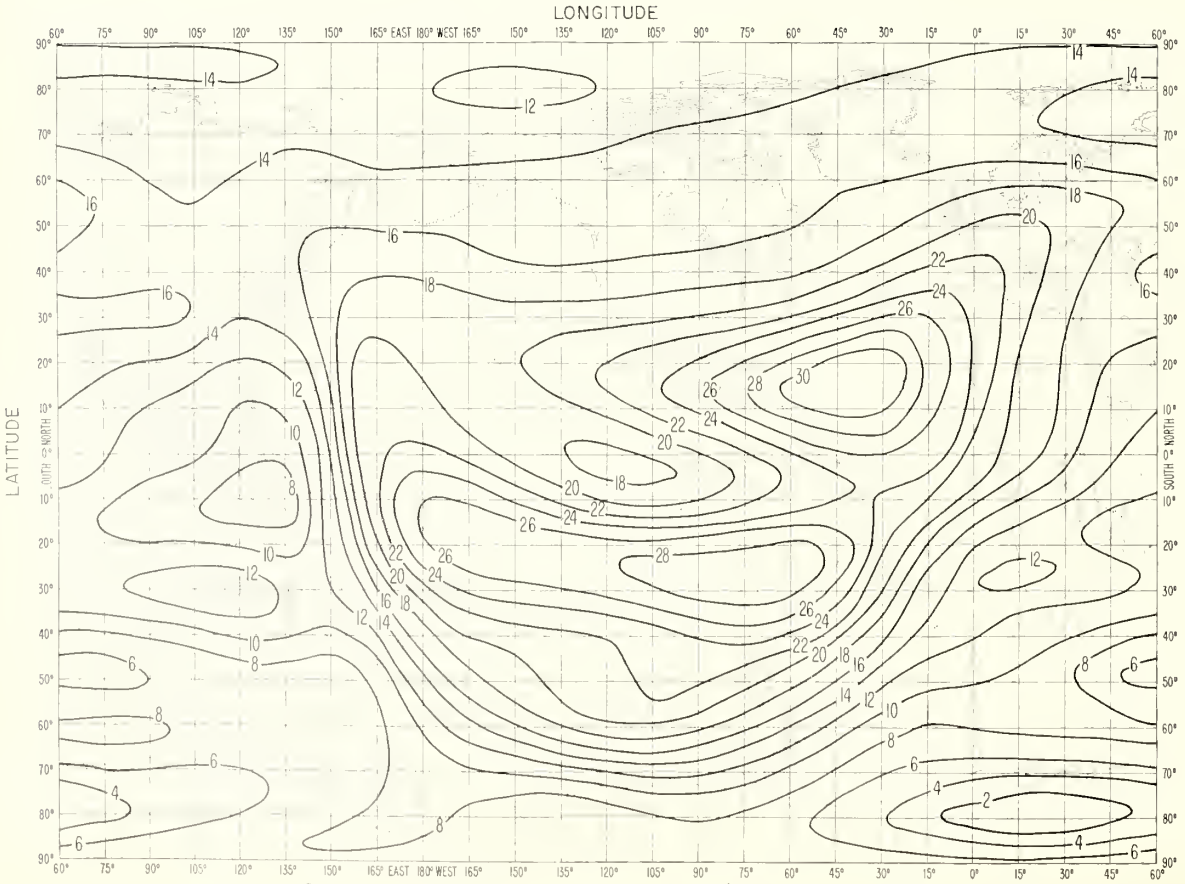

FIG. IIB. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

JUNE 1963 UT=22

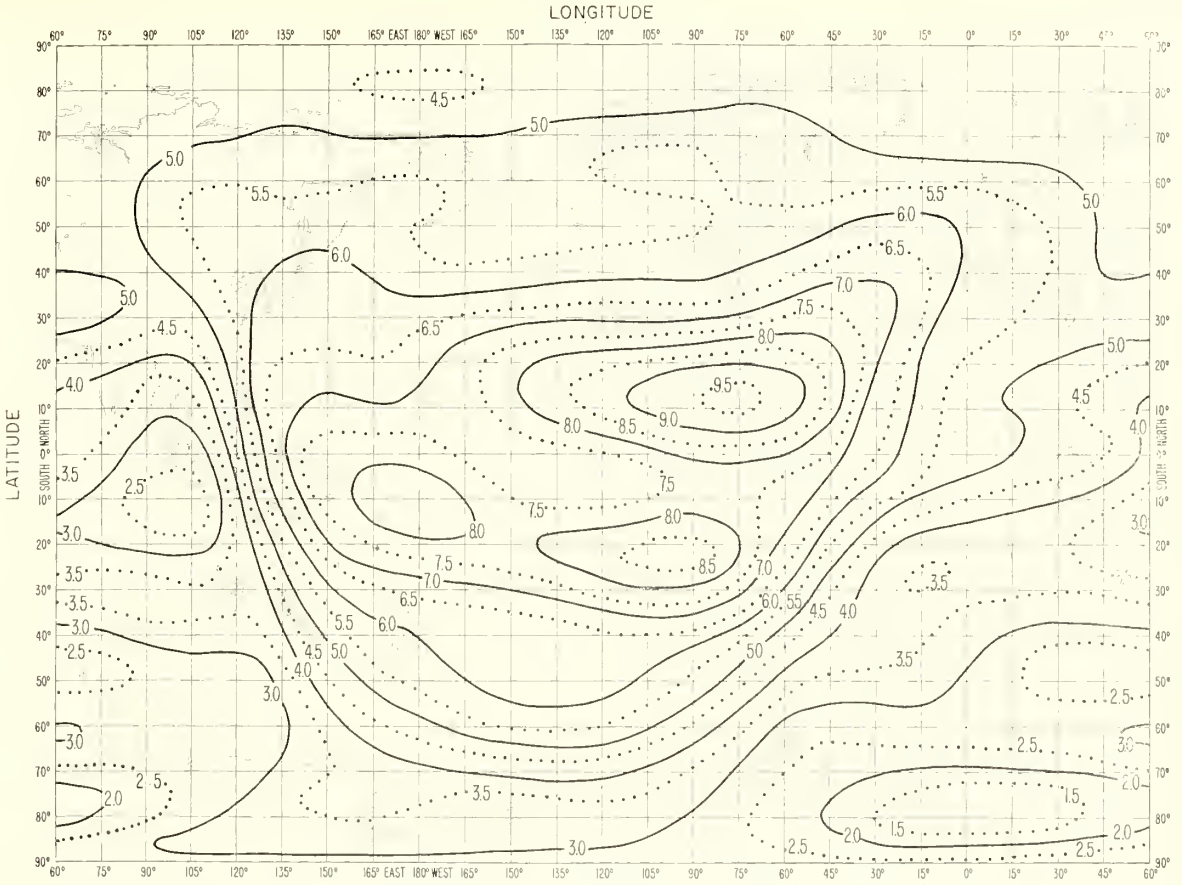

FIG. 12A. PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

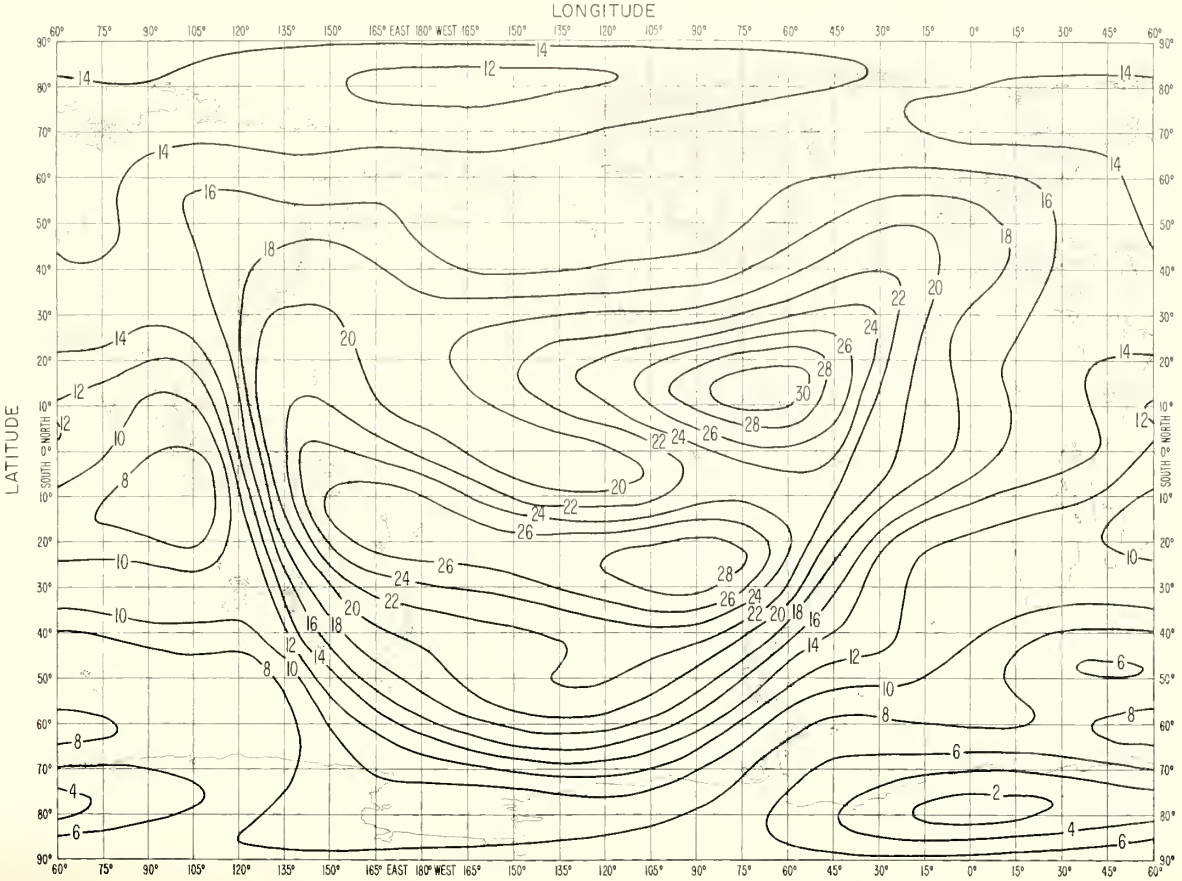

FIG. 12B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

NORTH POLAR AREA
JUNE 1963 UT=00

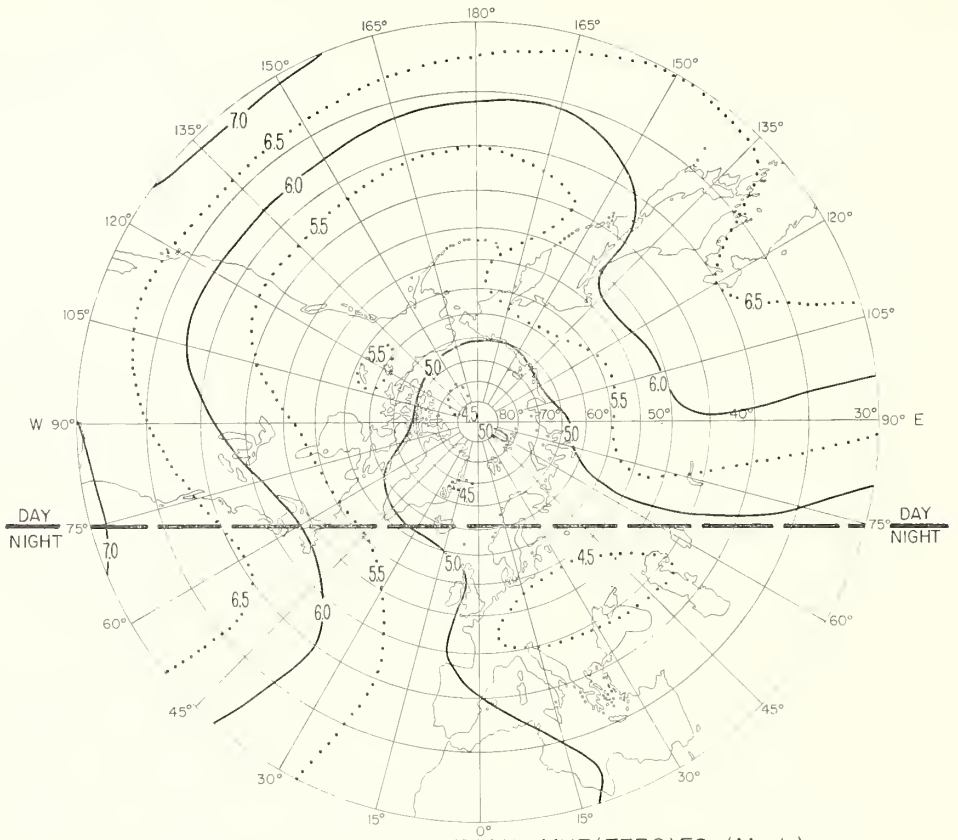

FIG. 13A. PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

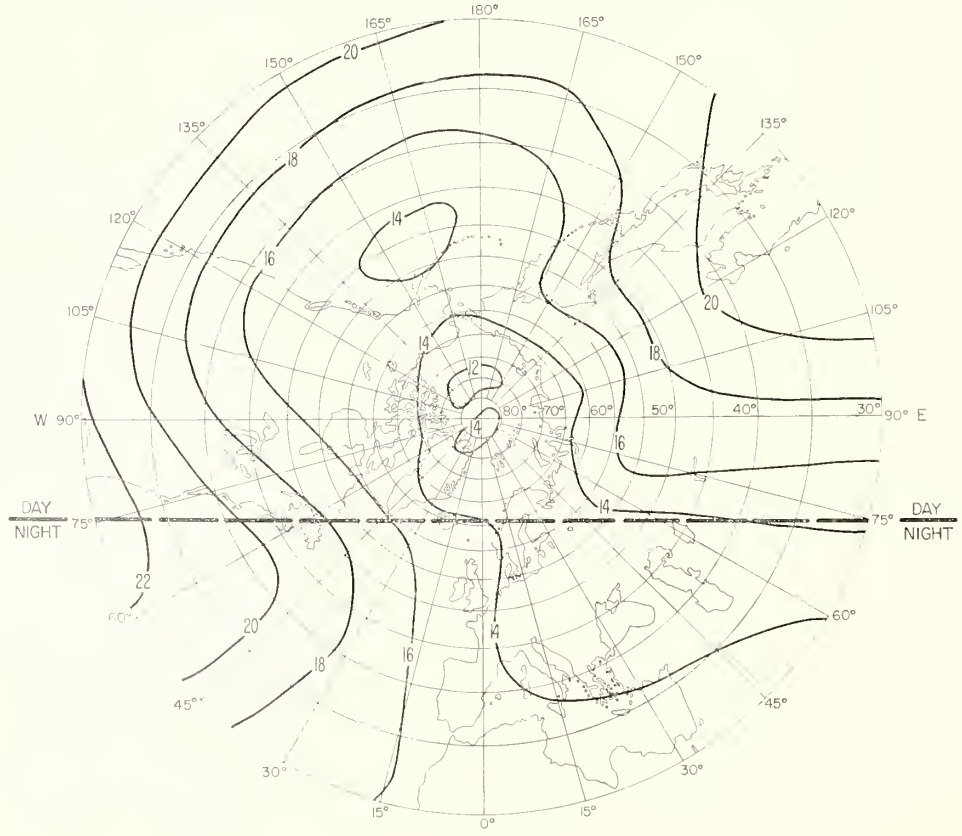

FIG. 13B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

SOUTH POLAR AREA
JUNE 1963 UT=00

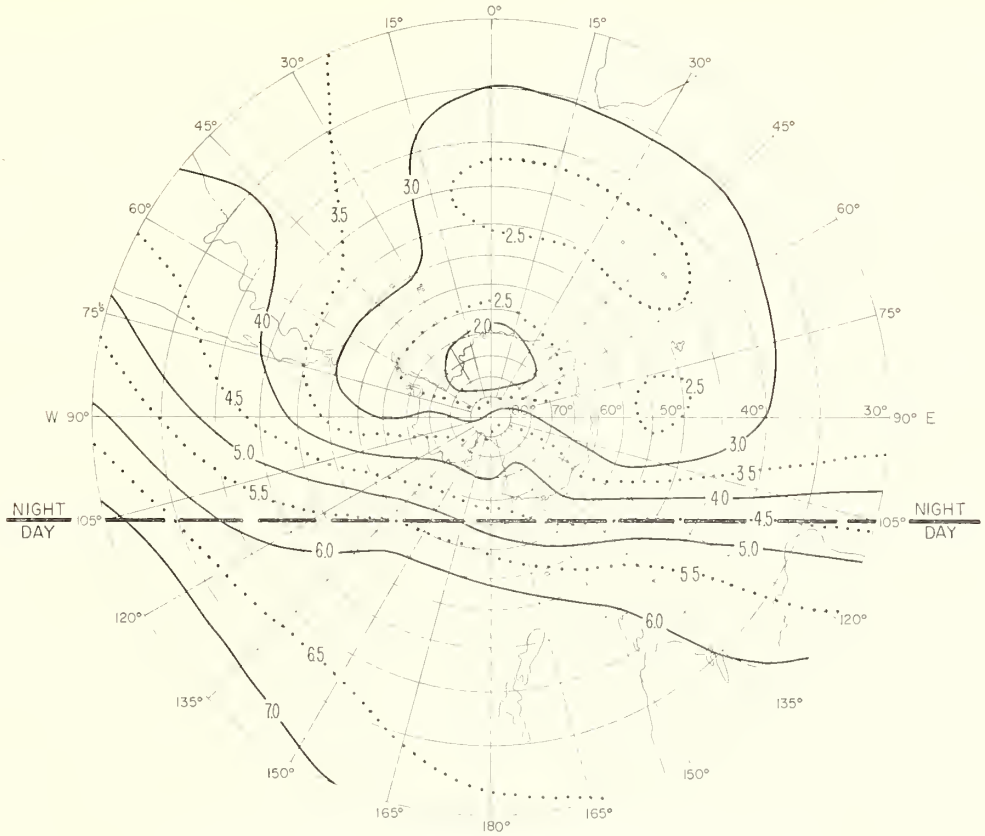

FIG. 14A. PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

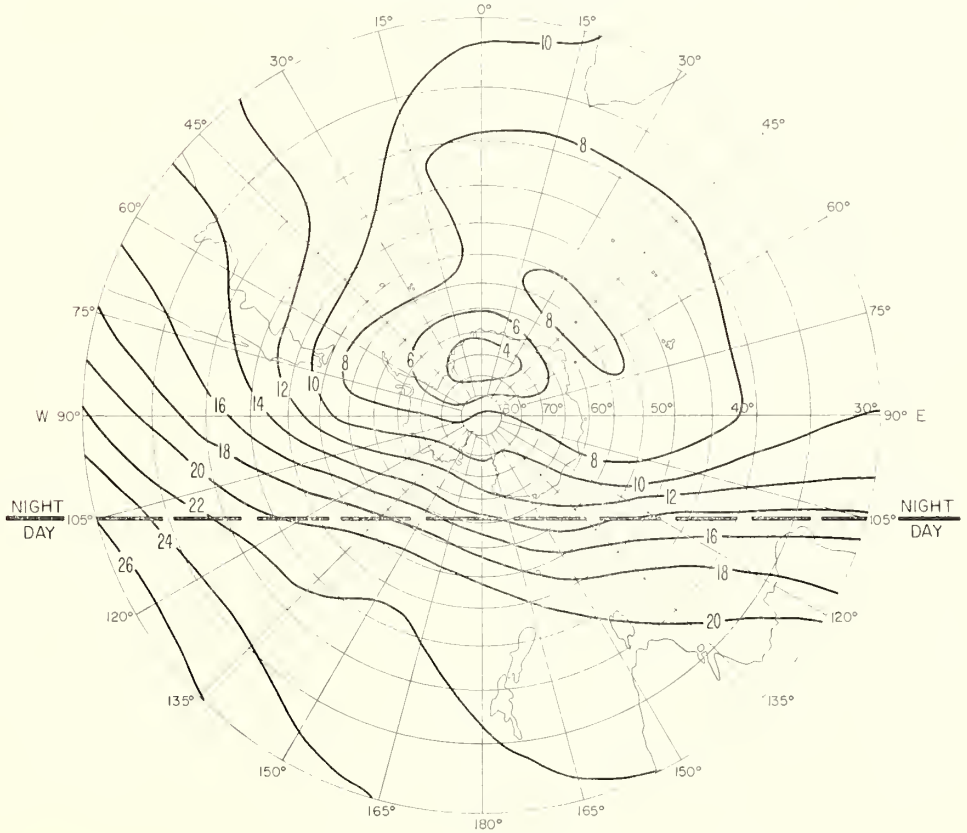

FIG. 14B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

NORTH POLAR AREA
JUNE 1963 UT=12

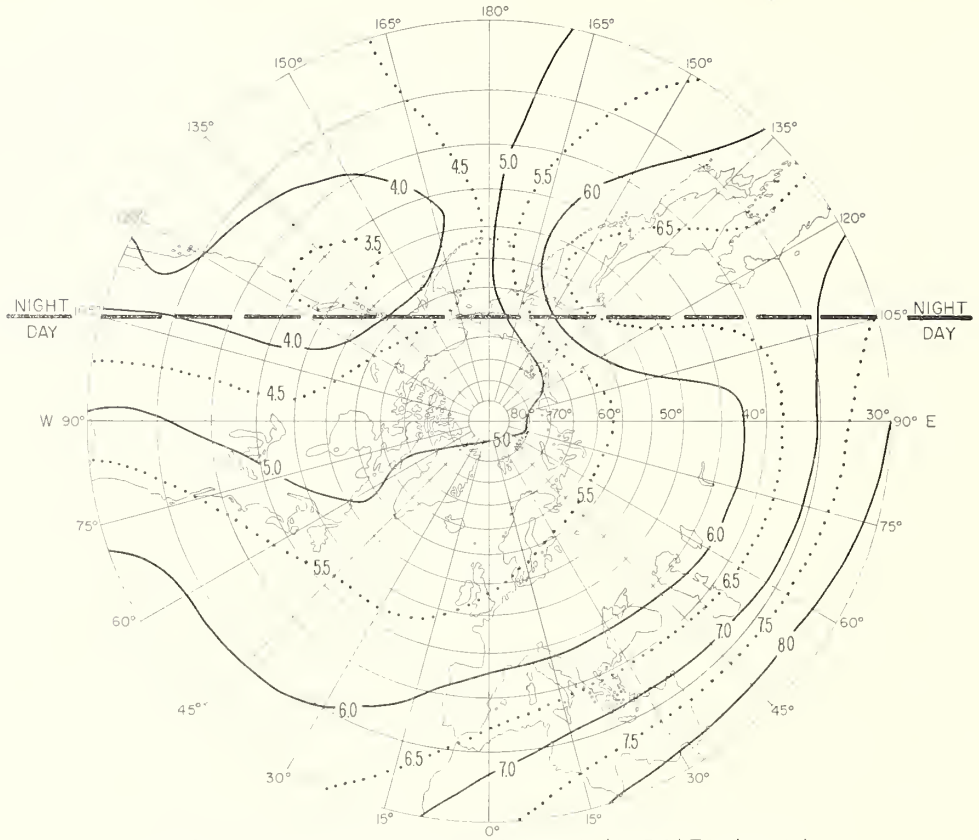

FIG.15A. PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

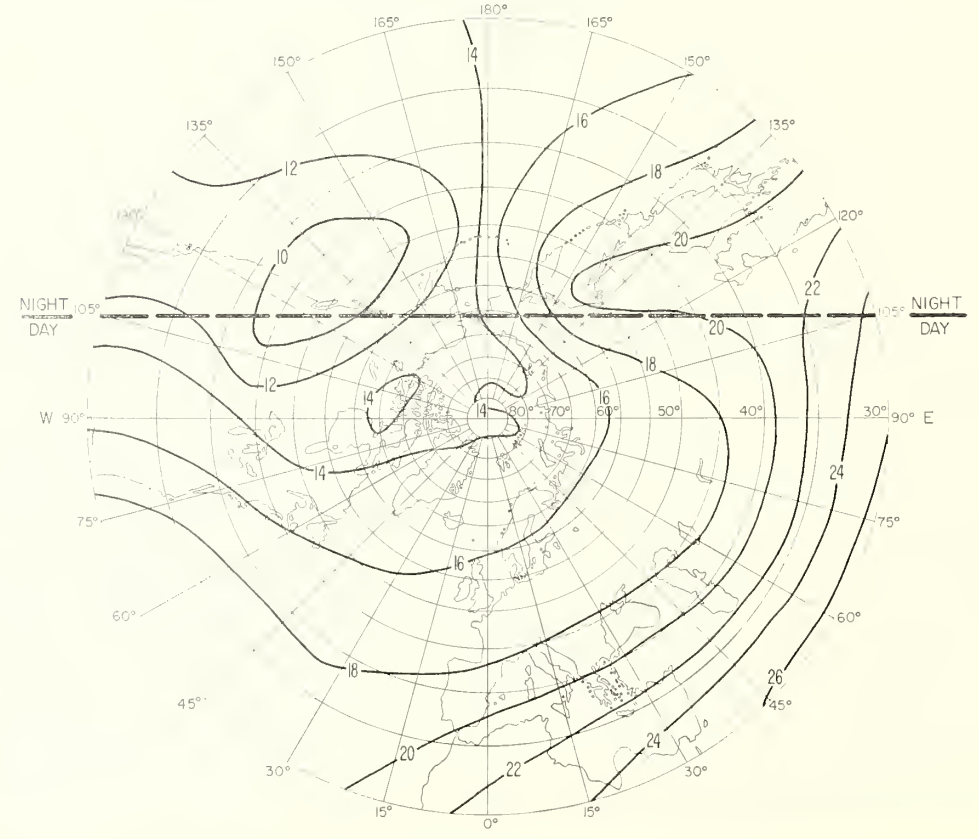

FIG.15B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

SOUTH POLAR AREA
JUNE 1963 UT=12

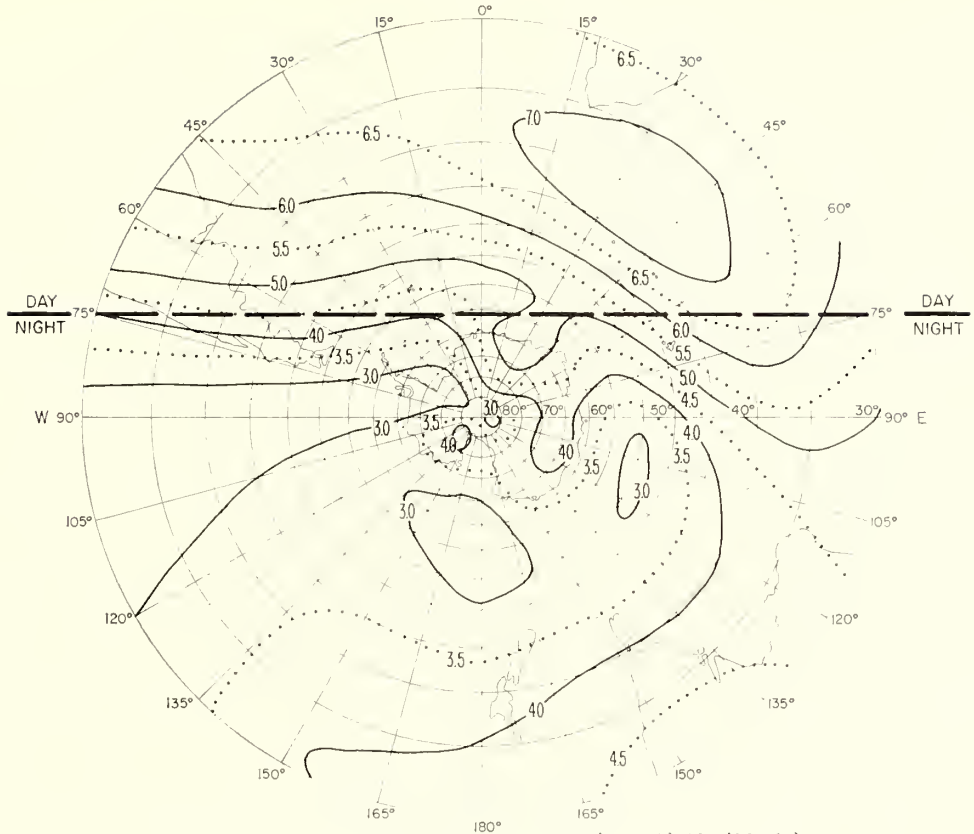

FIG.16A. PREDICTED MEDIAN MUF(ZERO)F2 (Mc/s)

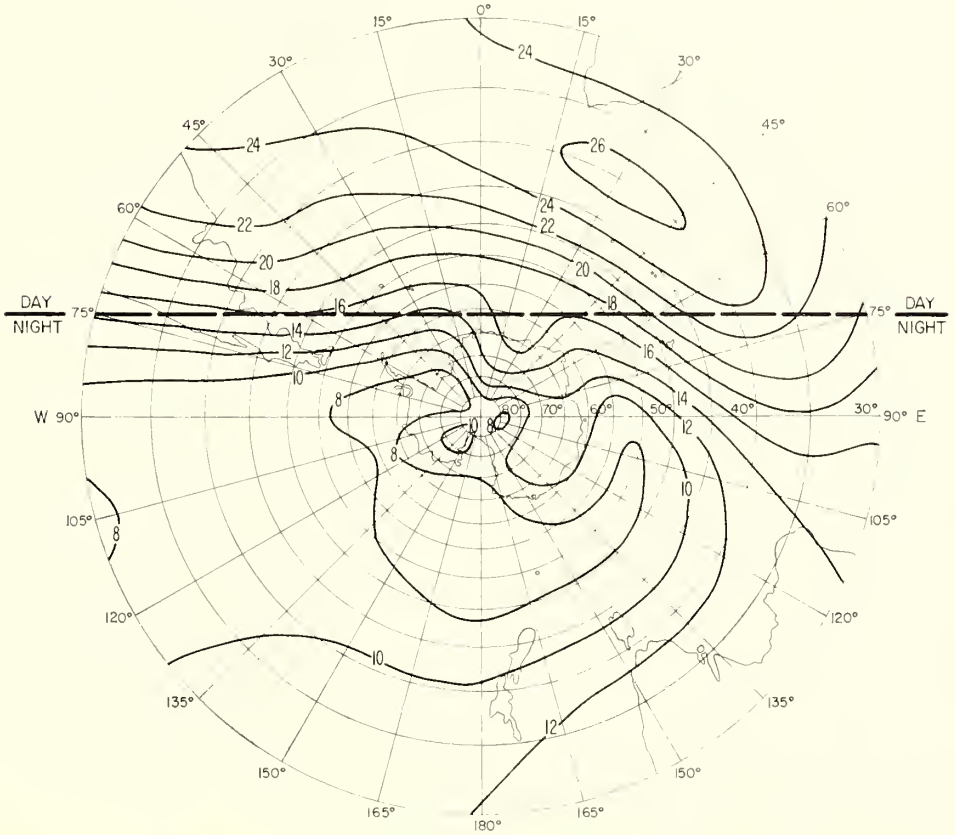

FIG.16B. PREDICTED MEDIAN MUF(4000)F2 (Mc/s)

U. S. DEPARTMENT OF COMMERCE
Luther H. Hodges, *Secretary*

NATIONAL BUREAU OF STANDARDS
A. V. Astin, *Director*

THE NATIONAL BUREAU OF STANDARDS

The scope of activities of the National Bureau of Standards at its major laboratories in Washington, D.C., and Boulder, Colorado, is suggested in the following listing of the divisions and sections engaged in technical work. In general, each section carries out specialized research, development, and engineering in the field indicated by its title.

WASHINGTON, D. C.

Electricity. Resistance and Reactance. Electrochemistry. Electrical Instruments. Magnetic Measurements. Dielectrics. High Voltage.

Metrology. Photometry and Colorimetry. Refractometry. Photographic Research. Length. Engineering Metrology. Mass and Scale. Volumetry and Densimetry.

Heat. Temperature Physics. Heat Measurements. Cryogenic Physics. Equation of State. Statistical Physics.

Radiation Physics. X-ray. Radioactivity. Radiation Theory. High Energy Radiation. Radiological Equipment. Nucleonic Instrumentation. Neutron Physics.

Analytical and Inorganic Chemistry. Pure Substances. Spectrochemistry. Solution Chemistry. Standard Reference Materials. Applied Analytical Research. Crystal Chemistry.

Mechanics. Sound. Pressure and Vacuum. Fluid Mechanics. Engineering Mechanics. Rheology. Combustion Controls.

Polymers. Macromolecules: Synthesis and Structure. Polymer Chemistry. Polymer Physics. Polymer Characterization. Polymer Evaluation and Testing. Applied Polymer Standards and Research. Dental Research.

Metallurgy. Engineering Metallurgy. Microscopy and Diffraction. Metal Reactions. Metal Physics. Electrolysis and Metal Deposition.

Inorganic Solids. Engineering Ceramics. Glass. Solid State Chemistry. Crystal Growth. Physical Properties. Crystallography.

Building Research. Structural Engineering. Fire Research. Mechanical Systems. Organic Building Materials. Codes and Safety Standards. Heat Transfer. Inorganic Building Materials. Metallic Building Materials.

Applied Mathematics. Numerical Analysis. Computation. Statistical Engineering. Mathematical Physics. Operations Research.

Data Processing Systems. Components and Techniques. Computer Technology. Measurements Automation. Engineering Applications. Systems Analysis.

Atomic Physics. Spectroscopy. Infrared Spectroscopy. Far Ultraviolet Physics. Solid State Physics. Electron Physics. Atomic Physics. Plasma Spectroscopy.

Instrumentation. Engineering Electronics. Electron Devices. Electronic Instrumentation. Mechanical Instruments. Basic Instrumentation.

Physical Chemistry. Thermochemistry. Surface Chemistry. Organic Chemistry. Molecular Spectroscopy. Elementary Processes. Mass Spectrometry. Photochemistry and Radiation Chemistry.

Office of Weights and Measures.

BOULDER, COLO.

Cryogenic Engineering Laboratory. Cryogenic Equipment. Cryogenic Processes. Properties of Materials. Cryogenic Technical Services.

CENTRAL RADIO PROPAGATION LABORATORY

Ionosphere Research and Propagation. Low Frequency and Very Low Frequency Research. Ionosphere Research. Prediction Services. Sun-Earth Relationships. Field Engineering. Radio Warning Services. Vertical Soundings Research.

Radio Propagation Engineering. Data Reduction Instrumentation. Radio Noise. Tropospheric Measurements. Tropospheric Analysis. Propagation-Terrain Effects. Radio-Meteorology. Lower Atmosphere Physics.

Radio Systems. Applied Electromagnetic Theory. High Frequency and Very High Frequency Research. Frequency Utilization. Modulation Research. Antenna Research. Radiodetermination.

Upper Atmosphere and Space Physics. Upper Atmosphere and Plasma Physics. High Latitude Ionosphere Physics. Ionosphere and Exosphere Scatter. Airglow and Aurora. Ionospheric Radio Astronomy.

RADIO STANDARDS LABORATORY

Radio Physics. Radio Broadcast Service. Radio and Microwave Materials. Atomic Frequency and Time-Interval Standards. Radio Plasma. Millimeter-Wave Research.

Circuit Standards. High Frequency Electrical Standards. High Frequency Calibration Services. High Frequency Impedance Standards. Microwave Calibration Services. Microwave Circuit Standards. Low Frequency Calibration Services.

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NG: None
USAR: None.
For explanation of abbreviations used, see AR 320-50.